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THE ART OF PRESERVING THE EYESIGHT.

Adapted from the French of ARTHUR CHEVALIER.

V.—PRESBYOPY, OR LONG SIGHT.

AMONG the commoner affections of the eye, there is one known to everybody as "long sight," or "presbyopy" (*presbyopia* of oculists).

In this affection, the rays of light, after crossing each other, go to form an image of the object *beyond* the retina, as may be seen in the figure (Fig. 46) at F. Now, by placing a converging lens before the eye, the rays are brought together before entering, and form an image exactly on the retina (F', Fig. 46), and thus perfect vision is secured. The causes of this affection of the eye are: (1) the hardening of the crystalline lens, so that its convexity can no longer be modified by the action of the ciliary muscle: (2) the shortening of the eyeball in its anterior-posterior diameter; (3) a diminution of the refractive power of the humors; (4) and a certain diminution of the sensitiveness of the retina. These causes, acting in different degrees, produce various stages of the malady, which may be characterized as

FEEBLE PRESBYOPY,

in which vision is possible at 12 inches, although painful and more or less confused according to degree;

MEDIUM PRESBYOPY,

in which vision is more or less confused or impossible at 12 inches, and for near objects, according to degree; and

EXTREME PRESBYOPY,

in which vision is utterly impossible for objects at 12 inches and for near objects in general.

It is generally believed that long sight is the portion of old age; hence the name, presbyopy, from the Greek *presbys*, an "aged man." However, notwithstanding it shows itself more generally at an advanced age, it is nevertheless of quite frequent occurrence among young persons. This is no doubt due to the social habits and the excesses unhappily so common at the present day. The predisposing causes of long sight are: dwelling in badly lighted places, close application to work on small objects, and the use of microscopes and other optical instruments. In the latter way the celebrated naturalists Leuwenhoek and Swammerdam became almost blind previous to their death. The illustrious astronomer Cassini lost his sight entirely, and Arago and Newton were almost blind during the latter part of their lives. Herschel had also enfeebled vision, since he often remained with his eye applied to the telescope for hours at a time; for instance, he looked for nine hours continuously to discover the satellites of Uranus.

The signs of incipient presbyopy are easily recognized. Thus, when it is desired to read or to look at small objects, the letters or things seem to be confounded; then the confusion increases and all appears cloudy; pains in the eyes are felt and a headache follows. Those who experience the first symptoms are usually much alarmed, and imagine that they have a very grave disorder. Convex glasses, however, carefully adapted, cause all these symptoms to disappear. If you ask such persons why they do not use spectacles they will tell you, generally, that they are waiting to see if the trouble will not disappear. Fatal mistake! *Presbyopy never retrogrades; it only tends to go on increasing.* The only method to follow consists in using good spectacles, chosen by a scientific person, and to use these according to rules that we will presently lay down.

By these means the malady progresses but slowly, and according to that fatal law of nature which causes the enfeeblement of all the organs of the body as years roll on. The whole thing is not to hasten this enfeebling by neglect, not to fight against the trouble when it makes itself felt, for the obstinacy which would lead a person to wish to dispense with spectacles will only aggravate the disease; and he who at its beginning might wear No. 48 will be obliged to use No. 24 glasses if he fights against them for some months.

It is especially by artificial light that this change in vision becomes perceptible, for almost all long-sighted persons can read for some time during the morning without the use of glasses. The long-sighted person has need of much light to see clearly; it is rare that a bright light fatigues him, and so he seldom has recourse to colored glasses. Long sight is often congenital, like short sight.

Long sight tends to become weaker, and the person afflicted is obliged at the end of a certain time to change the strength of his glasses. However, if the number selected at the beginning is well chosen, the sight may be preserved for a long time at the same degree of strength, especially by following the directions that we will give further on. But the necessity of changing the glasses just so soon as they become too weak must be insisted upon; and this necessity will be known by the fatigue they cause the eyes. An increase of a single number may do for several years. But usually the error is just here—a person delays and is eventually obliged to use two (or even four) numbers higher. It is by this false step that the eyesight is lost.

A long-sighted person whose eyes are fatigued by artificial light should abstain from all occupations that require a continuous application on the part of these organs, such, for example, as reading, writing, etc.

There are long-sighted persons (as there are short-sighted ones) whose eyes have different ranges; in this case lenses of different foci may be worn, but the difference must be quite perceptible, otherwise vision is less clear with different than with the same foci.

Although presbyopy proceeds slowly, it may nevertheless come on very suddenly with children and convalescents; care should then be taken not to use glasses, but to consult an experienced oculist. Presbyopy may be suddenly replaced by myopy (short sight); this often happens in the course of certain maladies of the eye, such as inflammation

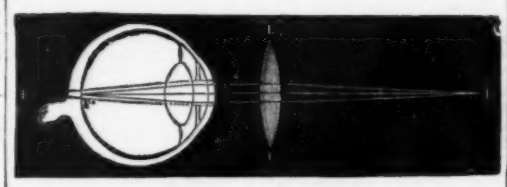


FIG. 46.—DIAGRAM TO EXPLAIN LONG SIGHT.

of the conjunctiva, etc.; but the disease having departed, vision appears again the same as it was before. When the presbyopy is pronounced, it will be necessary to have recourse to glasses of one focus for near objects and of another for distant. In this case the humors of the eye are so lacking in density, that even for distant objects vision is confused, and glasses of different foci become indispensable. But it should be distinctly understood that glasses of two powers are to be used only in this state of the malady—*extreme* presbyopy. Franklin spectacles may be worn in this case (Fig. 47). Of these glasses Dr. Franklin thus speaks: "It will be generally allowed, I suppose, that the convexity proper for reading is not suited for long distances. I had then, at first, two pairs of spectacles that I changed as occasion required; because in traveling I was sometimes reading and sometimes looking at the country. Finding the changing tiresome, never being able to do it quickly enough, I had the glasses cut and united again in the same setting, half of each of the two, as follows (Fig. 47). By this means, as I wore my spectacles constantly, I had only to lower or raise my eyes, according as I wished to see far or near." This device, so useful to every one, is especially so for artists troubled with short sight, who would not be able to copy a landscape without using such glasses. A particular form has been devised for artists in which a portion of the rim inclosing the lenses is removed (Fig. 48), so that turning them one way the wearer can readily see over the frame, and by turning them in the opposite direction he may see beneath it. In order that the Franklin spectacles may answer the end proposed, it is not necessary to make them by cutting a glass in two (each of which forms the segment of a circle); each segment should rather be made from a single piece of glass, in such a way that the optical center shall be

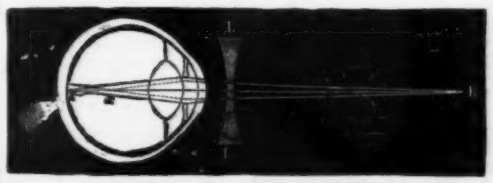


FIG. 50.—DIAGRAM TO EXPLAIN SHORT SIGHT.

found at the center of the segment. A very useful modification of the Franklin spectacles has been made, in which the two segments of the glass form, at their junction, a more or less open angle, and the optical axis always cuts the surface of the glass at right angles (Fig. 49).

The hygiene for long sight consists in not working by artificial light; often giving the eyes rest during work; taking off the spectacles and looking at surrounding objects; and while out of doors never exercising the eyes on distant objects, but trying them on those only that are quite near by. It is to be understood that the glasses will be of a number mathematically appropriate, and made according to the most approved methods. In this way a person may preserve his sight and use glasses of the same focus for an indefinite period. If, however, a person do not wish to deprive himself of the pleasure of reading by artificial light, he should strictly observe the following rules:

Read one hour at the most, and make use exclusively of an oil lamp giving a very bright flame. The lamp should be furnished with a shade, and even a reflector if the presbyopy is very bad. The lamp should be placed on the left side, the flame on a level with the shoulder.

☞ Absolute rule.—*A long-sighted person needs a great deal of light.* Candles and gas should be banished. Such lights are the source of a great number of visual maladies.

As regards the length of time to work, the patient should remember that he must spare his eyesight as much as possible; for, in spite of his using spectacles, he ought never to permit himself to do with his impaired vision what he might have done with impunity with his normal sight. He should never allow himself to use two different numbers of glasses, except in cases of extreme presbyopy; the number for regarding distant objects should always be about one-half the strength of that for reading; to this rule there are few exceptions. In feeble and medium presbyopy, only a single number should be made use of for looking at near objects, reading, writing, etc. The same number, when it has been properly chosen, may serve for both night and day use. A long-sighted person who wears spectacles adapted to his sight should take care to *read at a distance of from* 12 *to* 13 *inches at the most.* He should accustom himself to this, and never deviate from it at the risk, otherwise, of increasing his trouble. This is a matter of the utmost importance.

It cannot be too often repeated that the numbers, or foci, of the glasses should be mathematically chosen. If the proper number cannot be found in the market, ready made, they should be manufactured to order. For fear of selecting numbers that are too strong, people often make the fatal mistake of choosing those that are too weak, and thus the malady becomes rapidly worse. Under no pretext whatever should colored glasses be used, for the reason that we have before given—*presbyopy has need of light.*

Finally, the form of the glasses is by no means a matter of indifference. In feeble and medium presbyopy *periscopic* glasses should be used. These glasses are concavo-convex lenses, so placed that their curvature is in the same direction as that of the eye. By this arrangement a much wider range of vision is obtained.

VI.—MYOPY, OR SHORT SIGHT.

Myopy, or short sight, is almost as prevalent as presbyopy. Persons who are afflicted with this trouble are obliged to bring the book which they may be reading close up to their eyes; and often find it difficult to recognize the features of intimate friends at the distance of a few steps only. In this affection the rays unite and form an image of the object before they reach the retina, as seen in Fig 50, at F. A diverging lens placed before the eye separates them and causes them to fall exactly on the retina; by this means a clear image is formed. The causes that give rise to short sight are the opposite of those that cause presbyopy. The eyeball of the myope is elongated in its anterior-posterior diameter, the refractive power of the humors of the eye is very great, and the cornea is often more convex. There also exists a sort of excitation of the retina, not well studied. Such are the principal characters of *genuine myopy.*

There is also a *distant myopy* (*myopia in distans*). In this stage vision is good at a distance of 12 inches for near objects; but for distant objects negative or divergent glasses must be used if perfect vision be desired. It indicates a great weakness of sight, which should be anxiously watched. Thus, young *subjects should not be allowed to wear spectacles, neither in nor out of school.*

A remarkable thing in short sight is the habitual dilatation of the pupil. In normal sight a contraction of the pupil takes place in examining small objects, while the short-sighted eye, which sees such objects perfectly, does not contract. The eyes of myopes protrude more or less, and the cornea is more convex. In extreme cases of myopy there is always more or less strabism. Myopy has no tendency to decrease with age, except in the case of "distant myopy;" it may increase in intensity if too strong glasses be used, and, generally, if concave glasses are worn. It may be brought on by a habit of looking at small objects, by living in dark places, and by using glasses when the sight does not require them. We will see further on that *acquired* myopy is not the same as *genuine* myopy. *This affection, also, may be congenital.* The signs by which genuine myopy may be known are easy of recognition; they consist in the impossibility of distinguishing distant objects and in a necessity of approaching more or less near objects that it is desired to examine. We distinguish, as in presbyopy, three degrees of the malady:

FEEBLE MYOPY,

in which vision is clear at from 9 to 10 inches for near objects.

MEDIUM MYOPY,

where vision is clear at from 6 to 9 inches for near objects; and

FIG. 47.—FRANKLIN SPECTACLES.

FIG. 48.—SPECTACLES FOR ARTISTS.

FIG. 49.—FRANKLIN SPECTACLES.

EXTREME MYOPY.

in which objects can be seen clearly only at from 4 to 5 inches, and vision is confused for distant objects.

In these three degrees the rays proceeding from different objects form diffused circles, more or less pronounced, on the retina.

In order to choose glasses suited to both long and short sight an instrument is employed, which will be described further on; it must be remarked, however, that the focus indicated will always be *one degree too strong*. Thus if the myope reads at 4 inches (which will indicate No. 6 for reading) it will be necessary to prescribe No. 4 for seeing at a distance. The formula, so exact for presbyopy, becomes just as much so for myopy.

Perfect vision in short sight is not obtained so well by the use of glasses as it is in long sight. The myope can see perfectly only by using glasses that are too strong; this fatigues him and obliges him to use weaker ones that do not satisfy. *Concave glasses certainly increase myopy.* Thus a person who uses No. 24 at the age of twenty, will have need of No. 10 at forty, if he always wears spectacles. We will say, moreover, that a person cannot attain a degree of vision equal to that of the normal without using glasses that are too strong; this fatigues him and makes it necessary for him, in a little while, to obtain a higher number, and consequently his malady is increased, and other troubles manifest themselves in connection with it.

Optics, then, not being able to remedy myopy, as it does presbyopy, what is the short-sighted person to do? He must select glasses that do not fatigue him; these will not allow a normal range of vision, but they will have the advantage, at least, of not straining the eyes, since it will be necessary to use them only when it is de-ired to clearly distinguish objects. They must not be used for reading, unless in an extreme degree of the malady, in which work is rendered annoying, or impossible, from the necessity of approaching closely things that are to be examined. *The constant use of glasses, then, seems a very bad plan in myopy; the best thing to do is to have a pair of eye-glasses to use occasionally.*

To repeat; it is better to condemn one's self to see distant objects imperfectly than to run the risk of losing the sight entirely by the intemperate use of concave glasses.

A slight degree of myopy can be cured by a methodical use of the eyes—in reading print that is moderately large, and putting the book further and further from the eyes, and doing this several times a day. In feeble myopy effort should be made to do without glasses as much as possible, and the eyes should be exercised as just indicated.

And now as to the choice of glasses. Short-sighted persons do not have recourse to glasses as quickly as long-sighted ones, and they always begin with numbers that are somewhat high, such as 20 or 18. All the harm proceeds from the first glasses that are selected. If, at the beginning, the advice of an able optician be sought, he will select a suitable number and give proper directions as to how the eye should be exercised. Thus vision may be preserved as perfectly as possible for a long time.

It is important to use extreme care in choosing glasses for short sight, especially if the myopy be caused by regarding near objects, in which case it is called *acquired myopy.* Here very weak glasses will be necessary. Acquired myopy cannot be modified as well by the aid of glasses as congenital. This malady, in our opinion, is only an increased stage of distant myopy, brought on by an excess of work on near objects. There is probably here a weakness which does not exist in genuine myopy. In extreme myopy, if the number be well chosen, glasses should be used only when absolutely necessary, and that for seeing at a distance; for reading they should be discarded. As stated, the best plan is to have a pair of eye-glasses, to use from time to time. Myopes should wear colored glas es when they go out into the sunlight, for an excess of light is bad in short sight.

The eyes of myopes very often have different ranges, one being very short-sighted and the other only feebly so. In such a case glasses should not be used for the very short-sighted eye. The hygiene for myopy consists in looking at near objects as little as possible, reading or working very little in the evening, exercising the eyes on distant objects, never making use of spectacles but only of eye-glasses (so as not to have glasses always before the eyes), and using, when necessary, glasse. of a pale bluish-black tint.

We have spoken thus far of genuine myopy; we have said that their exists a *false myopy*, or distant myopy. In this singular affection a person is a myope for far and near—he can read the characters on this page at a distance of normal vision, and to see far off is obliged to use concave glasses varying between Nos. 36 and 18. The limit of 18 is never passed. If he strains his sight on near objects he passes to acquired myopy, and may afterward, on this account, have visual troubles that it is impossible to modify. The person afflicted with distant myopy becomes long-sighted with age, and then convex glasses are used as for presbyopy.

Such then are the different kinds of myopy that we unhappily meet with at every instant.

[Continued from Supplement No. 135.]

NERVOUS EXHAUSTION.

By George M. Beard, M.D., Fellow of the New York Academy of Medicine, Member of the American Neurological Association, etc.

Mental Depression with General Timidity.—In disease, as in health, fear is one of the symptoms of weakness—an emotion with which the instinct of self-preservation envir ns every form of incapacity. In our half-awakened moments at midnight a slight noise causes the heart to beat rapidly, for we are conscious of not having full possession of our powers to meet any attack or danger. The nervously-exhausted man is always in this state, physically insolvent, and unequal to efforts that require much vital expenditure. In that form of nervous exhaustion known as sexual exhaustion, senseless timidity is one of the diagnostic features; fear of society, fear of the indefinite future, unwillingness to enter upon any enterprise, inability to look one squarely in the face, downheartedness and indefinite distrust. Patients of this kind will walk up and down before a physician's office many times before venturing to enter. This timidity becomes a serious matter in business, making success very difficult. One of my patients troubled with cerebral exhaustion, of very large wealth, and great business experience, tells me that, desiring once to borrow, on perfect security, some money for a certain business purpose, he walked several times up and down the front of the office of the capitalist whose aid he sought, before he could summon the strength to go in.

The mental depression of the nervously exhausted is largely independent of external conditions, although it may be aggravated by them—especially by bad weather; a certain amount of blood and nerve force is needed for happiness.

A very eminent theologian and preacher, who consulted me three or four years ago, told me that when he had charge of a parish, the responsibility of sitting in his pulpit and listening to a traveling agent exhausted him more than preaching himself, for the reason that he continually feared that the stranger would say or do some indiscreet thing.

Responsibility of any kind, without any labor, even when unconscious, may powerfully affect the system, and in various ways. Thus a young man whom I knew, who was badly troubled with seminal losses, causing great nervous exhaustion, resolved to try the woman cure, and made regular appointments with a lady friend. It was a new experience for him, and he professed to have no pleasure in the sexual act, and felt somewhat timid and distrustful about the matter. The consequence was that the responsibility of meeting his appointment would always cause him to have free passages from the bowels, although generally he was very constipated.

Morbid Fear of Special Kinds (Agoraphobia and Astraphobia).—Fear of leaving home, of going out of the house, of going anywhere alone, of crossing a ferry, of crossing an open square, of going through a narrow alley, of going away from the neighborhood of shops or open places of refuge, are some of the phases that this symptom develops. This symptom is not very common, but when it does occur it is very annoying and sometimes quite obstinate. It is a ludicrous and absurd symptom, but it may occur in persons of intelligence and ability and good sense. It is analogous in some respects to the utter helplessness that some experience when standing on an elevation; the will is put to rout completely, and cannot rally at the call of reason.

I was consulted not long ago by a physician, who was so harassed by this symptom of nervous exhaustion that he was unable to attend to his practice. His physical strength was sufficient, but on account of the agoraphobia he could not go any distance from his office with any comfort. He would be working in his garden, but when requested to go a mile, or even less, to see a patient, he could not respond. On walking out with him one morning I observed that he turned the corners often so as to keep about such a distance from the hotel, where he was stopping. Under electrical and other treatment the physician is improving, and is attending to his profession.

Dr. C. L. Mitchell tells me of a gentleman who was so badly agoraphobic that he was unable to leave his house without company, and accordingly he paid a man $20,000 to be his constant companion. There have been men who, by this symptom, have been kept as close prisoners as though within the walls of a penitentiary. In some instances, though not in all, this strange symptom seems to be traceable directly to sexual excess of some kind.

Sometimes very bad cases of this malady entirely recover. I have known three persons who were unable to cross the Brooklyn Ferry, and all got well in a few weeks or months.

My friend, Dr. D. E. Smith, of Bronxville, N. Y., tells me of a lady who is unable to cross Harlem river on the cars, and consequently cannot visit New York city.

I have now under my care a lady in whom the agoraphobia takes the form of inability to go to church. It was in church that she was first taken with a peculiar and hard-to-be-described lightness of the head; and she now feels that she could do almost anything else rather than attend church. Ability to do that she would regard as the best and strongest sign of recovery. A young business man, who was first attacked with bad symptoms in his factory, dreaded to enter the building, until, under electrical treatment, he recovered.

The term *astraphobia*, or fear of lightning, I have applied to that form of nervousness that is painfully affected before and during thunder storms. Headaches, neuralgias of various kinds, depression, spasms, are some of the symptoms of this state, which, in some instances, is hereditary, and runs in families.*

Fear of Society is a phase of morbid fear that is common enough in all forms of nervous exhaustion, but is, perhaps, most often noticed in sexual complications. With fear, blushing of a senseless but overpowering character is often combined; the victims are ashamed to enter the presence of ladies—to enter the presence of any one; they cannot look any one in the face, but in conversation keep their eyes turned down or aside.

Sick Headache and Various Forms of Head Pain.—Sick headache is both a symptom and a safety-valve. If one must be nervous an occasional attack of sick headache, if it be not too severe, is an excellent way for this nervousness to manifest itself, and no doubt saves other and worse affections. When sick headaches suddenly and permanently leave us there may be reason to beware, though not probably in all cases. Some years ago I had under my care for a short time a case of shaking palsy that had followed a sudden and apparently causeless cessation of sick headache. When sick headache leaves us, as a result of improvement of the nervous system through treatment or hygiene, it is so far forth a good sign.

Like most of the symptoms of nervous exhaustion I am here describing, sick headache is experienced mostly between the ages of fifty and fifteen. Rarely, or never, do young children have it, and it usually stops before old age. It is a symptom that belongs to the perturbable and active years, and may quickly show itself when, from any cause, the nervous system is depleted of its force.

Pain and Heaviness in the back of the head and over the vertex and through the whole head very commonly attend the neurasthenic state—especially when the brain is congested; but many also appear where there is no evidence of an excess of blood on the brain. Lightness of the head is also a common complaint; also a symptom usually defined as "I cannot tell how I feel."

Here I may remark that very much has been said, is now said, and for a long time probably will continue to be said of circulatory disturbances as the pathology of all these and kindred symptoms; and when such a symptom is declared to depend on cerebral or spinal anæmia or hyperæmia, it is supposed that we have solved all the problems that relate to it For a number of years I have been contending that circulation is a result of innervation. The brain and spinal cord, impoverished of nerve force, are unable to maintain the balance of the ebb and flow of the blood of the arteries and veins; consequently anæmias and congestions arise that may be transient or more or less permanent. But the disease is not the anæmia nor the hyperæmia (although both anæmia and hyperæmia, when they occur, may and do induce certain symptoms peculiar to themselves); but it is the neurasthenia—the nervous exhaustion, the decline in the quantity or quality of nerve force—that presides over the circulation, although it cannot, like the blood, be weighed, measured, analyzed or studied under the microscope. This view, though scarcely listened to, and not at all understood, when first pressed, is now slowly gaining its way among the neurologists, both of Europe and America.

There may be anæmia of the nerve-centers without exhaustion, as after hemorrhages; and there may be sudden congestion of the spinal cord, from taking cold, or of the brain from various causes—but these are not the conditions of which I am here speaking. They occur in those who are not nervously exhausted; indeed, congestions are more likely to occur in the plethoric and strong; they come rather under the head of acute and traumatic disorders.

Disturbances of the Nerves and Organs of Special Sense.—Nervous exhaustion often causes dilatation of the pupils—sometimes dilatation of one pupil and contraction of the other. These conditions are temporary and changing—not permanent—as in certain organic diseases.

Another malady of the eye is what I may call neurasthenic asthenopia, or the irritable eye, from nervous exhaustion, not depending on any muscular or accommodative trouble, but symptomatic purely, revealing nothing to the ophthalmoscope or other tests of modern ophthalmology, but none the less painful, distressing and sometimes exceedingly obstinate. This disease of the eye, symptomatic of nervous exhaustion, I observed and called attention to a number of years ago, but could find no formal recognition of it in the standard text-books of ophthalmology. But, very recently, Dr. Mathewson, in conversation on the subject, tells me that this third form of asthenopia is now, under various names, coming into recognition in the journals and societies devoted to diseases of the eye.

An attack of this neurasthenic asthenopia—which is oftimes so severe that reading or writing or sewing is accomplished only with great pain, and the eyes are painful and tender on pressure even when not used—an attack of this kind may last half an hour, or three hours, or three months; and, like analogous states in other parts of the body, with which it is often accompanied, may come and go very suddenly. In looking at the eye when in one of these attacks we observe often a passively-congested state of the conjunctiva. This congestion is a result—not the cause—the effect of the nervous irritation, and comes and goes under exciting causes. Such, without question, is the pathology of cerebral irritation, of spinal irritation, of irritation of the mammæ, the ovaries and testes, and of sick headache and many other forms of neuralgia. The notion which has been advocated—that this neurasthenic asthenopia, or irritable eye, is peculiar to women, and always reflected from the uterus, and therefore to be called uterine asthenopia, is but an adumbration of the truth; for the malady, though most common in women, like all this family of symptoms, is found in both sexes; the very worst cases I have ever seen have been in males. Several of my cases have been examined by our best experts in ophthalmology. This form of eye weakness is quite susceptible to the influence of psychical contagion. A number of years ago it spread through many of the colleges and seminaries of the country—in some instances compelling young men to abandon their plans of liberal education.

Muscæ Volitantes, or floating specks before the eyes, often annoy even the slightly nervously exhausted; in these cases the ophthalmoscope is only of negative assistance. Under exciting causes the specks suddenly appear and disappear. The liability to them may be a habit of one's life.

Noises in the Ears in the shape of sudden explosions or pulsations, to say nothing of other varieties of tinnitus aurium, are quite common in cerebral exhaustion, especially when attended with congestion. These explosions may come on without any warning, while one is sitting quite still, and there is no apparent exciting cause. These symptoms may occur even when there is no perceptible disease of the auditory apparatus, and may disappear as suddenly as they appear. A feeling of fullness and oppression in the head sometimes attends these symptoms. Subjective odors of various kinds—as of ozone or phosphorus; also abnormal subjective tastes—bitter or sour, likewise fleeting symptoms of cerebral exhaustion are observed.

Localized Peripheral Numbness and Hyperæsthesia.—In any portion of the periphery—the face, the arms, the ends of the fingers, the thighs, the legs and the toes—there may be, in nervously exhausted patients, persistent numbness of a definitely localized character, or excessive sensibility, similarly localized. In some cases this local peripheral hyperæsthesia amounts to a very distressing disease. I was once consulted by a physician who had hyperæsthesia of the left hand, caused apparently by local injury acting on a nervous diathesis. The condition was very obstinate, and caused much distress. I once had under my care a lawyer who had a burning feeling in the thumb and fingers of the right hand, with pain sometimes running up the arm. At first I suspected that the symptoms were premonitory of writer's cramp. The patient went to Europe and took various treatments under the direction of Charcot and other neurologists without important benefit, but is now able to pursue the routine of his profession. I have now under my care a gentleman who has had for a long time a sensation of numbness and burning at the ends of his thumbs, at the bottom of the heels, and around the legs and ankles. These symptoms are accompanied by the usual symptoms of cerebral exhaustion and congestion—pain in the head, a feeling of fullness and pressure, and mental depression. Sometimes there are flying, stinging, pricking sensations in the feet and legs, that caused one European physician to make the diagnosis of "flying gout." With hygiene and electrical treatment this patient has improved in a manner most encouraging, and, what is of chief interest just here, the improvement in the peripheral symptoms has exactly kept pace with the improvement in the brain symptoms, showing their common nature.

Symptoms of this kind excite fear and dread—oftentimes as indicating grave and structural brain disease, or as premonitory of apoplexy; but in the majority of cases they are the results and signs of functional, not structural trouble, and occur in people who live to old age.

I have seen a number of cases where there was numbness on a limited area of the thigh, and all have recovered or permanently improved without a very bad history.

Among other special symptoms coming under this head I may mention a *crawling or creeping* as of insects just beneath the skin—a sensation as though a pin or many pins were just touched to the skin; a tendency for the legs and arms to "go to sleep," under far slighter pressure than in the normal state of health, is observed in cases of this class. Sitting a very short time in a hard chair, riding in an omni

* Beard & Rockwell's "Medical and Surgical Electricity," 2d ed., p 456.

bus or car or carriage may cause the foot to get asleep, when, in entire health, no such effect would have been produced by the same cause.

I have now under my treatment a man who often wakes up at night with a strong but transient sensation of numbness in the little finger and inner side of the third finger, confined to the track of the ulnar nerve. In other cases other nerves of the arms may be involved, and all the fingers may be numb. Numbness of this kind usually goes away after a little shaking and rubbing. It is more likely to come on at night from lying on the arm; but in the daytime, also, it may occur when the arm rests for a few moments over the back of a chair. When one is specially exhausted or worried from any cause this transient and local numbness is more likely to show itself. The pathology of this state is probably, if not certainly, an obstruction in the passage of the nerve force through mechanical pressure. In the highest health sufficient pressure will produce this condition, and if the pressure be kept up permanent paralysis may occur; but in nervous exhaustion, when the nerve force moves slowly and with very little *vis a tergo*, much slighter pressure suffices to obstruct its passage—just as water flowing slowly through a rubber tube can be checked by a gentle touch of the finger, but if flowing rapidly and with great force needs a stop-cock.

General and Local Chills and Flashes of Heat.—Disturbance of circulation both follows and accompanies disturbance of innervation. Creeping chills up and down the spine are commonplace; but there are symptoms allied to this not so familiar. Thus Dr. J. H. Sterling had under his treatment, at one time, a lady whose knees were literally as cold as ice—that is, they felt to her as cold as though they were packed in ice. I knew of a case where there were limited and small areas of heat and cold sensations on the arms. I have also known cases where the ankles were cold, even when other parts of the body were comfortable. After fatigue or worry, the penis and scrotum, as well as the ears, or one ear, and one foot or both feet, and one hand or both hands, may be cold to the touch—even in warm weather, and in a hot room, or when thickly wrapped up. Patients in this state are, indeed, like Harry Gill, very, very cold, no matter what they put on; the skin may be almost blistered, as they stand near the fire, and yet chills are running all over them.

Long writing, which may produce symptoms of writer's cramp in others, may in the nervously exhausted person cause coldness of the fingers, hand or arm, especially when the arm is elevated. Yet more minutely may this symptom of coldness be localized; spots as small as the point of a pin apparently—especially on the face—may be pinchingly or stingingly cold—this sensation quickly appearing and quickly disappearing.

Local Spasms of Muscles.—What are called "fibrillary contractions," and which sometimes occur in progressive muscular atrophy, are also noticed in the various shades of nervous exhaustion. An individual muscle or part of a muscle may twitch occasionally or frequently, so as to cause considerable annoyance, and in some cases unnecessary anxiety. As these vibrations occur in the orbicularis and other muscles of the face these spasms are very familiar; they come and leave without warning, and suddenly. I was once conversing on nervous diseases with a well known physician, when, all at once, the orbicularis of one of his eyes began to twitch vigorously; he said it was the first time in his life that he had experienced anything of the kind; he regarded the use of tobacco as the probable cause.

The stomach, in nervous dyspepsia, may be the seat of similar spasms, which may follow any excitement or emotion, as of fear or responsibility. A sensation like that of a reverse aura seems to go downward to the pit of the stomach from the nerve centers, and excite spasm, apparently, of the muscles of the stomach itself.

I close with these suggestions:

First.—The above detailed symptoms are not imaginary, but real; not trifling, but serious; although not usually dangerous. In strictness, nothing in disease can be imaginary. If I bring on pain by worrying, by dwelling upon myself, that pain is as real as though it were brought on by an objective influence. Modern science is built up in a degree by observations of phenomena that all the ancient and mediæval world regarded as beneath observation. Is not the observing and right interpreting of subtle, obscure, elusive and out-of-the-way phenomena of disease the best test of scientific skill?

Secondly.—These symptoms of nervous exhaustion are, in a measure, interchangeable—antagonistic to each other—and nervous exhaustion is itself antagonistic to many other diseases—especially of the acute and inflammatory sort. Diseases prevent disease; diseases cure disease; diseases are antidotes to disease. Sufferers from chronic neurasthenia are safer in the midst of epidemics than others are; they are not subject, as are the robust and full-blooded, to violent and fatal fevers; and when attacked they are more likely to survive. To this numerous class of sufferers it is, then, a consolation that their disease is itself medicine and hygiene. Opium-eaters, I am told, are comparatively exempt from malaria, and in the East pass unharmed through the epidemics of cholera.

Likewise alcohol inebriates do not usually suffer from ordinary nervous exhaustion. Excesses of any kind that injure us in one way may save us from being injured in other ways. Alcohol seems to act as an internal counter-irritation.

The *interchangeableness* of these symptoms is also noteworthy. In nervous exhaustion nothing is constant except inconstancy. The symptoms chase each other like the shadows of summer clouds across the landscape. The moment one leaves another and several stand ready to take their place. In a single day one may go through the whole gamut of all these notes of disease.

Thirdly.—The *periodical and rhythmical* character of some of these symptoms is of much interest.

While this paper is being revised, I have been consulted by a clergyman of middle life, who, with many other symptoms of neurasthenia, is troubled with attacks of special and peculiar depression, lasting about a day, more or less. These attacks are ushered in usually by a feeling of mental exaltation; then comes diplopia, with other abnormal phenomena of vision, and so on through quite a regular series of nervous symptoms. Prostration from heat was the original cause of the attacks, which are now brought on by any mental or physical exhausting or disturbing influence. The patient finds that a drop or two of belladonna taken during the stage of exaltation will always break up the attack, and now he always carries a bottle of that remedy in his pocket. I once had under treatment a young man who had attacks of nervous depression every day about noon; they lasted but for a short time, but were as periodic as chills and fever—and like chills, and like the preceding case, passed through definite stages.

Fourthly.—Nervous exhaustion is compatible with the appearance of perfect health.

For this reason, as well as on account of the slippery, fleeting and vague return of their symptoms, patients of this class get but trifling sympathy. Sometimes they are fat and hearty, and have a ruddy, vigorous, strength-suggestive bearing; sometimes also they grow fatter as they grow worse. Noticeably the disappearance of symptoms in the stomach, and the appearance in their stead of symptoms in the brain and spinal cord, are followed by increase in weight that deceives the friend, the physician, and even the patient himself. Thus it happens that patients get the least sympathy when they most need it.

Four years since a prominent politician consulted me for a medley of nervous symptoms induced by sunstroke—a not uncommon cause of neurasthenia. He was an enormous herculean man, but gave a history that would well have befitted the most delicate and hysterical woman.

Fifthly.—Nervous exhaustion is a modern disease, and pre-eminently an American disease, and in this country is chiefly found in the North and East. This disease must, therefore, be studied here; we cannot, as in so many other diseases, look to Germany for light and information—for in Germany this condition is comparatively unknown, and in France and England is far more rare than with us. It is a disease almost exclusively of the well-to-do classes, and can, therefore, be satisfactorily studied only in private practice. Medical treatises founded entirely on hospital and dispensary experience are of little service to those who desire guidance in the analysis of this or of kindred disorders.

Sixthly.—The treatment of nervous exhaustion should be in general of a sedative and tonic character; should not be exclusively applied to any one of these special symptoms, but to the whole condition—to the main trunk and not to the separate branches. Electricity in central and general applications with both currents, varied and abundant food, passive exercise, as *massage*, in some cases, absolute rest in bed, in others mild, active exercise and the judicious use of such remedies as relate to the nerve-centers, counter-irritation by very small blisters, or the actual cautery, dry cold to the urethra through the cooling catheter, for the special form known as sexual exhaustion; fats, fish and phosphates of various kinds—and internally cannabis indica in small doses, combined with the bromides, strychnine, of course, with Calabar bean, the preparations of zinc and arsenic, gelseminum and bromohydric acid, caffein, malt and oil—under this system of treatment, adapted with care and study for individual idiosyncrasies, and combined with right hygiene, the majority of cases of neurasthenia can be permanently relieved, if not substantially cured.

A REDUCING REAGENT.

By EGIDIO POLLACCI.

THE base of the reagent in question is hydrated ferric oxide, prepared and applied as follows:—Introduce into a flask 2 to 3 c.c. of distilled water, into which is put, by means of the end of a small glass rod, about half a drop of an aqueous solution of pure ferric chloride, and then three or four drops of caustic soda dissolved in distilled water, and finally is added the substance to be examined. This being done the mixture is shaken, heated to a boil for a minute or two, and then, after having withdrawn it from the fire, a drop of concentrated sulphuric acid is added. This having been done, the tube is cooled, by letting water fall upon it, and when the liquid is sufficiently cool the tip of a small glass rod is introduced with half a drop of a freshly prepared solution of pure ferridcyanide of potassium (red prussiate). If the addition of the ferridcyanide does not give rise at once to the production of Prussian blue, the suspected substance contains no reducing agent. A blue coloration more or less heavy indicates, on the other hand, the presence of a reductive substance.

CLIMBING SALTS.

By M. H. PELLET.

A LARGE proportion of salts have a tendency to climb; those which descend are chiefly of a deliquescent nature, such as carbonate of potassa and chloride of calcium; nitrate of lime, however, has a remarkable climbing tendency. The nature of the soil (coarseness or fineness of its particles, proportion of moisture, etc.) influences the ascent of salts. In one and the same soil, a part of the salts may be carried downward by moisture, and if evaporation from the surface is resumed, may anew begin to ascend. The extreme layers of the permeable soil will always be found richest in fertilizing matter, while the intermediate portion is impoverished. Superphosphate of lime is remarkable for its climbing powers.

CHLORIDE OF LIME.

EMIL MALETRO has devised a revolving apparatus with agitators for the manufacture of dry chloride of lime. A cylinder of thick pewter contains the powdered lime. Below and at the sides are closely-fitting doors. In the axial line is a roller fitted with arms and pewter shovels which makes 12 to 20 revolutions per minute, and keeps the contents in constant motion. Chlorine gas enters the cylinder above by a pipe fitted with a tap. A thermometer which passes through the side of the cylinder shows the progress of the operation. Above are two apertures, with valves, for the escape of heat and moisture. A cold-water jacket serves to prevent an excessive rise of temperature in summer. The product, when finished, falls through a door opened below into trucks placed to receive it. The speed of the process and the uniform quality of the product are important advantages of the new method as compared with the old process as conducted in large lead chambers.

ACTION OF WATERY VAPOR.

By M. COQUILLION.

THE author has previously pointed out the increase of volume produced on passing hydrocarbides over palladium wire, heated to redness along with a proportion of oxygen insufficient for their combustion. He has now examined under what conditions and to what extent this augmentation of volume is produced. These reactions throw a light upon the part played by hydrocarbides in blast-furnaces, and show the influence of watery vapor, which facilitates their dissociation, producing at the same time a fall of temperature, which is added to that due to the transformation of carbonic acid into carbonic oxide.

THE ACTIVE PRINCIPLES OF ERGOT.

THERE has been considerable controversy for many years as to the precise nature of the active principle of ergot, and the drug has been the subject of frequent investigation. In 1864 Mr. William T. Wenzell communicated to the *American Journal of Pharmacy* the results of an exhaustive examination of the drug, and announced the discovery of the alkaloids *ergotina* and *cebolina*. To the latter the peculiar effects of ergot were supposed to be due. More recently two important papers on this topic have appeared in Germany—one by Messrs. Dragendorff & Podwissotzky, and the other by Mr. Theo. Blumberg—and the conclusions reached by the authors not only differ from those of Mr. Wenzell, but throw much additional and valuable light on what has been an obscure subject. Messrs. Dragendorff & Podwissotzky have now proved that the most active constituent of ergot is an acid termed *sclerotic acid*, found in combination with potassa, soda and lime, forming, with these, salts which are freely soluble in water. This, however, is rivaled in action by a colloidal substance, *scleromucin*, which is obtained in connection with the acid. *Sclerotic acid* is a yellowish-brown, tasteless and inodorous substance, having a very slight acid reaction, and is hygroscopic without being deliquescent. It is well adapted for subcutaneous injections in doses of 0·03 to 0·045 gramme.

Scleromucin is darker in color, slightly hygroscopic, gummy, inodorous and tasteless. Good ergot yields about 4 to 4½ per cent. of the acid and 2 to 3 per cent. of scleromucin.

The following coloring matters have been isolated from ergot: Yellow crystalline scales of *scleroxanthin*, in combination with pale-yellow needle-like crystals of *sclerocrystallin*, as well as an amorphous mass which has been called *sclerioidin*.

The most important coloring matter of all, however, is one termed *sclererythrin*. In addition to these substances Dragendorff & Podwissotzky also isolated a bitter alkaloid, which they call *picrosclerotin*, and a yellow acid which they term *fusosclerotic acid*. A solution of the alkaloid injected into frogs produced decreased sensibility, paralysis of the extremities and death, in 10 or 12 minutes, without convulsions. These authors also found that Wenzell's cebolina and ergotina contain admixtures of different salts and foreign matters, and they regard the two as one and the same thing; this opinion is likewise shared by Blumberg. Blumberg has also isolated the crystalline alkaloid ergotinina, observed by Tanret in 1875.

CADAVERIC ALKALOIDS.

By PROF. F. SELMI.

IN the course of toxicological experiments the author has discovered, in extracts obtained from the bodies of persons who had died naturally, several substances possessing the general characters of the alkaloids, and has found that they are derived from the spontaneous decomposition of the cadaveric matter. Some of them are fixed, and others volatile; some are soluble in ether; others insoluble in that medium, but soluble in amylic alcohol; and others, again, insoluble in both these liquids. Generally the fixed cadaveric alkaloids yield a precipitate with almost all general reagents. Some of them are precipitated by platinic chloride, with argento-potassic cyanide, and with potassic bichromate. They may give rise, with iodureted hydriodic acid, to crystalline compounds often resembling those formed by the same reagent with certain vegetable alkaloids. They yield colored reactions which, however, in certain cases are not produced according to the conditions of putrefaction. Of these colored reactions the following are the principal:—Sulphuric acid, moderately concentrated, gives a red-violet coloration. Hydrochloric acid, mixed with sulphuric acid and applied hot, a red violet. Sulphuric acid and bromine water, a red coloration more or less distinct, which fades after a certain time. Nitric acid, gently heated, and followed by potassa, gives a beautiful golden yellow. Iodic acid, sulphuric acid, and bicarbonate of soda form a violet-rose more or less distinct. These compounds are easily oxidized, and turn brown on exposure to the air, evolving a special urinous odor; at other times the smell is like that of conicin, and sometimes they exhale a perfume like that of certain flowers. They generally possess a pungent taste which benumbs the tongue; in some cases the flavor is bitter. Some of these compounds have no injurious effects upon animal life, but others are powerfully poisonous. The symptoms produced are transient dilatation of the pupils, slackening and irregularity in the pulsations of the heart, and convulsions. After death the heart is found contracted and void of blood.

HEAT BY A CHEMICAL ACTION.

By T. L. PHIPSON.

IF a fragment of calcic hypochlorite is held before the orifice of a tube from which issues a rapid current of sulphureted hydrogen, the following phenomena are remarked: All odor of sulphureted hydrogen disappears immediately, and is succeeded by a strong smell of chlorine. A slight deposit of sulphur is formed upon the solid fragment, and the disengagement of heat is so rapid and intense that the hypochlorite can scarcely be supported in the fingers. The sulphhydric acid displaces, therefore, the hypochlorous acid, liberating chlorine as do the other hydracids, that is to say, the hydrogen of these acids is burned by the oxygen of the hypochlorous acid, the chlorine of the latter becoming free. In the present case the hydrogen is burnt so rapidly that a slight deposit of sulphur is formed upon the hypochlorite, but the bulk of the sulphur is burned to sulphuric acid at the same time as the hydrogen.

DECOMPOSITIONS OF STRYCHNINE.

By R. SCHIFF.

STRYCHNINE introduced into nitric acid dissolves with the evolution of heat and the production of abundance of nitrous vapors. On diluting the solution with water, there is formed a yellow amorphous precipitate, a mixture of a base and of a neutral body. To separate these two compounds, they are dissolved in glacial acetic acid, and precipitated with water. The neutral substance is thrown down as a yellow amorphous powder, while the base remains in solution, and may be precipitated with sodium carbonate. This latter product appears to be nitro-strychnine. If the solution of strychnine in concentrated nitric acid is heated for some hours on the sand-bath, and allowed to cool, a yellow crystalline substance is deposited, the quantity of which is considerably increased on adding water to the liquid. This compound is an acid of the composition $C_{15}H_{11}N_4O_{15}$.

A COTTAGE, COSTING $150.

By S. B. Reed, Architect, Corona, Long Island, N. Y.

These plans are for an economical cottage, for an occasional summer residence of a family of four persons. It is suited to almost any place, either by the water or on the mountain, where rest and recreation are sought. It costs scarcely more than a first-class family tent (which it is designed in a measure to supplant), and is far preferable, as it affords better protection and accommodation, and is more convenient and comfortable. It also admits of some of the home-like ways of living. Tents supply little comfort; their form necessitates a cramped, disagreeable position, with barren walls, and very small facilities for housekeeping. They sway and vibrate with every wind, and are intolerable in a storm. Out-door shade, so desirable in summer, is usually already provided by large trees. A single low tree, with extended branches, may shade several cottages, and serve as a support for swings and hammocks for the young folks. In connection with the building, stationary

Fig. 1.—FRONT.

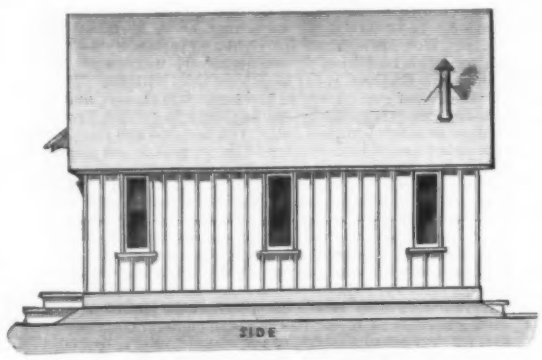


Fig. 2.—SIDE VIEW OF SUMMER COTTAGE.

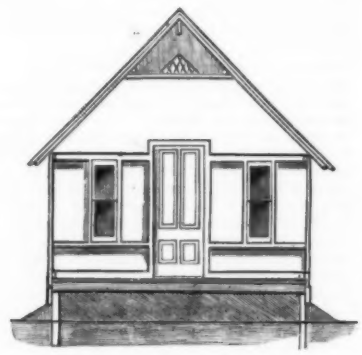


Fig. 3.—INTERIOR OF FRONT.

fixtures for bedsteads, tables, etc., arranged to fold up when not in use, save largely in room and furniture expenses. Exterior (Figs. 1 and 2).—The upright boarding and battening of the sides, the figured, gable barges, hooded projections, and steep roof, are appropriate in material and style. The building is set one foot above the ground, and the space below is inclosed by turfing around to the level of the sill. For better appearance, and to raise the floor further from the ground, an additional foot or two of elevation may be given, with increased banking or terrace. Accommodations (Fig. 6).—The interior has two rooms and two closets. The front portion, intended for the family-room, is of fair size, with two windows in each of two sides, and three doors, as shown. A folding-bed is built in one corner, and a large shelf between windows at A; sufficient room remains for a center-table, chairs, etc. The rear room, or kitchen, has two windows, an outside door, and a closet. A circular

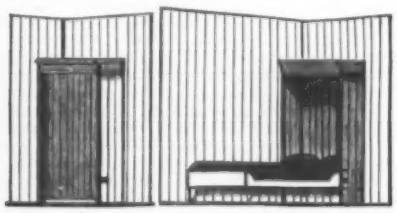
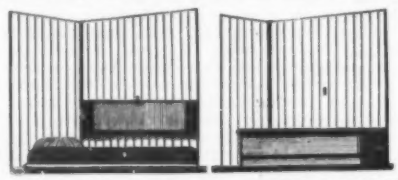


Fig. 4.

BED CLOSED. BED OPEN.

shelf and a stove are placed at the side of the closet. A bunk placed in the opposite end of the room serves as a seat during the day, and for a bed at night. A table is hung against the partition. Construction.—The foundation may be of stone, or posts set in the ground. The floor timber is framed together—leveled on the foundation, and floored over, and the edges cut even with the sills. The upright frame 1¼ x 5-inch plank, and the plates 1¼ x 6 inches, are then placed in position, with openings for doors and windows, as shown in Fig. 4. The exterior boarding, dressed on both sides, is then put on and battened. The roof is similarly boarded—with the center portion ceiled down, leaving an air space above. At the ends of this air space in each gable are openings through the siding for the passage of the heated air from under the roof. Similar openings in the ceiling over the center of each room lead into the air space. Each opening is neatly finished with lattice work. The roof projects 8 inches and has a 3-inch marginal strip all around, with pierced barges in each gable, covered with pine shingles. The door openings are protected by shingled hoods resting on dressed trusses. The windows are neatly capped. Each window has battened shutters, with wrought-iron hinges and fastenings. The inside framework (see Fig. 3) forms the jambs of the doors and sashes, to which they are hung with ordinary butts. The intervening spaces show as panels. The inside partition is 6⅛ feet high, and has an 8-inch cap projecting mostly to the kitchen side; this cap strengthens



BUNK OPEN. Fig. 5. BUNK CLOSED.

the partition, and forms a shelf. The outside and partition doors are paneled; the others are battened and clamped. The kitchen closet has four shelves, and the other, or front closet, has one shelf and two rows of hooks. The circular shelf at the side of the kitchen closet is set level with the bottom of the sash, and has a sheet of zinc attached to its inner edge extending to the floor, protecting the surrounding wood-work from the heat of the stove. The table is 2½ x 4 feet, is hung to the partition, and supported on swinging braces. The bed frame is constructed of ceiling boards, as shown (see Fig. 4); when opened, answers the purpose of a bedstead, and when closed serves as a closet for the bedding. The bunk (see Fig. 5) is also of ceiling boards clamped together. These devices are easily made by

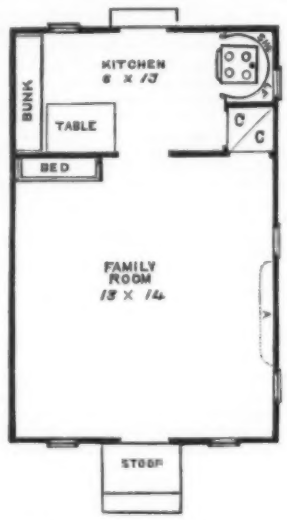


Fig. 6.—FLOOR PLAN.

any carpenter, are inexpensive, and answer their purpose acceptably. The outside has two coats of paint, of any desired color, prepared and applied in the usual manner. The inside is stained with oil.

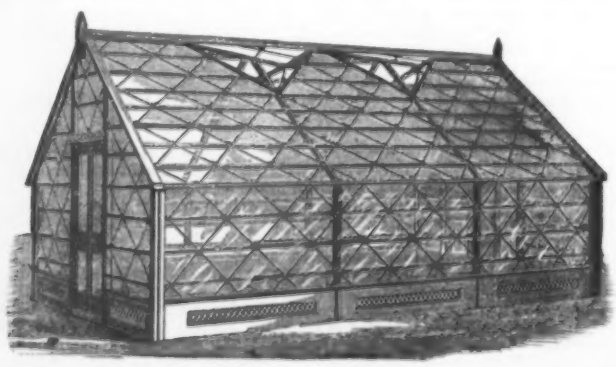
Estimate, cost of materials and labor:

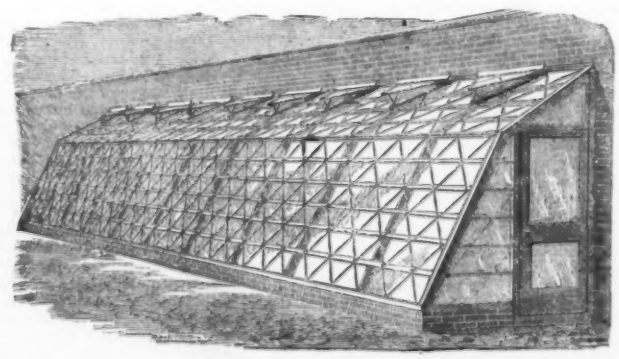
378 feet of timber, at $15 per M	$5 67
2 sills, 3 x 7 in., 20 feet long.	
11 beams, 3 x 7 in., 13 feet long.	
1 ridge, 2 x 7 in., 20 feet long.	
2 purlines, 3 x 4 in., 20 feet long.	
30 flooring boards, at 28c. each	8 40
53 ceiling boards (dressed both sides), at 28c. each	$14 84
54 ceiling boards (dressed one side), at 28c. each	15 12
53 battens (half round, 1½-inch wide), at 6c. each	3 18
10 planks, $3.50; 15 boards, at 28c. each, $4.20	7 70
14 bunches shingles, at $1.25 each	17 50
6 sashes, $6.00; 3 paneled doors, at $1.15 each	9 45
2 lengths of tile pipe, at 50c. length	1 00
Hardware, nails, and incidentals	16 14
Painting, $25.00; carting, $6.00	31 00
Carpenter's labor, not included above	20 00
Total cost, complete	$150 00

—*American Agriculturist.*

BUILDINGS IN GLASS.

Greene & Son, of Saffron Walden, Eng., have introduced the following improvement in the method of fixing the glass of lean-to roofs or conservatories. It is a new form of metal clip to receive the corners of square panes, the panes being arranged diagonally—that is to say, with the corners at the top, bottom and sides, as seen in our illustration. The panes of glass are also arranged to overlap, the upper ones above the lower, and thus to thoroughly throw off all rain. The surface of the glass covering is thus completely flush, without sash-bars or ridges to catch the rain or dirt. The appearance of such a glass roof will therefore always be clean, with a complete glassy surface, and the diagonal arrangement will add to the picturesque effect. The metal clips are riveted direct to light iron purlines, or bent round strips of metal which may be riveted to the purlines. This metal clip is in form something like a tally, having one projecting tag at the top which forms the means of attachment, and the lower part spreads out into a triangular shape, with its upper sides cut into three strips. The center strip of these three, one on each side, is bent upward, and thus forms a rest, against which the neighboring side panes respectively rest. The two outside strips are bent downward, and under the top corner of the lowest pane of glass, which is thus firmly secured. The side panes are then placed over the lowest one to lap according to taste, till they rest securely against the middle strips of the clip, before described as being turned upward. These middle strips may then be turned down upon the two side panes—a projection upon these strips further serving to support the bottom corner of the next pane above. Each clip is thus a plain piece of metal stamped or cut to the required shape, and answers the purpose of firmly securing four corners of four different panes of glass. In the case of the bottom rows of panes, the large or square panes of the second row rest with their bottom angles in the clips, and right and left of it the panes are portions only of a similar square. In this case only three panes are in contact with each of the bottom clips. The parts of the clips which in the upper rows turn over the top angles of the lower panes are here secured to the first supports, each clip being intended to support the pane immediately above it and the side adjacent panes. In a roof of this kind there is a complete exclusion of rain and snow, as the whole roof is glass over glass—as complete as is the case in a slated roof. There is also freedom of exit for products of condensation and perfect liberty for the expansion and contraction of the glass. The arrangement of the laps insures their being washed perfectly clean by a shower, and there is also a maximum of light and absence of vertical shadows. There must be also considerable economy in cost of construction, as no after painting of sash bars and no glazier's putty-work are required. Any unskilled amateur could fix his own glass, and in cases of breakage or renewal no glazier need be called in, if a few spare panes of glass are kept on stock for such contingencies. There thus seem to be many points of improvement in the form of roof we have described, and no doubt glass construction will be much facilitated by such an invention.—*Iron.*





BUILDINGS IN GLASS.

[Continued from SUPPLEMENT No. 133.]

TOBACCO AT THE PARIS EXHIBITION.

ON passing by the show cases in the Champ de Mars where the different kinds of manufactured tobacco are exhibited, one is struck by the infinite variety of products which are used in its fabrication, from the most common cigars to the best Havanas, from the most inferior tobaccos to the aromatic Guibeck. In each country, indeed, the taste, form, and appearance of the manufactured products vary with the caprice of the day, and it is one of the duties of the manufacturer to satisfy the requirements of the public, and to direct them often to the development of new tastes. But for the manufacturer, and to the man who studies the subject carefully, all these products are classified under five categories, having each their distinct mode of preparation, viz., tobacco in powder or snuff, chewing tobacco, the cut leaf, cigars, and cigarettes.

According to tradition, it was under the form of smoking tobacco, either for pipes or cigars, that the Congress of the New World developed the use of the plant in Europe, and it was not till many years after that its preparation as snuff was introduced. Naturally at the commencement the details of the manufacture were of the crudest possible nature, but it quickly became complicated as the tastes of the smokers grew refined, and it became a species of alchemic or pharmaceutic preparation, of which the traces still remain in certain countries, as, for example, the numerous recipes of Saumure, quoted by Ladislas von Wagner in his "Treatise on the Manufacture of Tobacco and Cigars." Toward the middle of this century the manufacture of tobacco rose beyond the empirical stage to enter into the domain of practical science, and to adopt fully the method of a great industry. To the tobacco department of the French Government the honor must be given of having inaugurated this new departure, to which other nations quickly addressed themselves; it is sufficient to visit the pavilion devoted to the exhibits of this department at the entry of the Champ de Mars, near the Pont d'Jena, to appreciate the application obtained by the uses of science.

It will be readily understood that we cannot enter into great detail of each of these apparatus, but the description which we can give will convey a sufficiently clear idea of their operation, at the same time that we describe the processes of manufacture. For more clearness we will follow the method that we have already adopted in indicating the classification of the products.

To consider first tobacco in the form of snuff, the superiority of the rappee of the French Government factories is incontestable. It is known that for a long time the manufacture had arrived at a high degree of perfection as regards the flavor of the products, but it is only since the labor of M. Schlessing in the chemical and of M. Rolland in the mechanical department that the process has been organized in a perfectly regular and economical manner. Chemically the process consists in subjecting the tobacco to two kinds of fermentation, one in the open air to develop the aroma, and the other in closed vessels to bring out the strength. The first results in the destruction of the nicotine, the second in the removal of organic acids, especially of citric acid and ammoniacal products. But in both cases it is absolutely necessary to avoid putrid fermentation and decay, and with this object the leaves are moistened with salt water. Mechanically it involves several preparations—the moistening of the leaves and stalks, cutting before putting them together in masses for the first fermentation, cleaning the fermented leaves, moistening them before the second fermentation, and, finally, sorting and packing. Damping is effected by means of mechanical appliances, which consist of a wooden cylinder about 16 ft. long, placed horizontally, furnished with a spiral in the interior, and to which is imparted a rotary motion. The leaves are introduced at one of the ends, where they receive a quantity of water proportioned to their weight, and forced in by a pump, the discharge from which can be regulated. This apparatus acts like an Archimedean screw, and allows of the moistening of about one ton of leaves per hour; it has the advantages of regulating the damping and reducing the amount of débris, independently of the improvement in the uniformity of work produced.

The first cutting is performed by means of helical knives mounted on a drum, against which the cake of pressed leaves is fed by grooved cylinders. This cake is cut up in slices about 3 ins. wide; the pieces are then mixed with the débris, and a mass of from 35 tons to 40 tons weight is formed, care being taken in doing so to facilitate the circulation of air after the first fermentation, which lasts from five to six months; after this the tobacco, the aspect of which is considerably changed, is ready for the next operation.

This, that of grinding, is entirely automatic, and a model at the Exhibition one-fifth full size shows clearly the arrangement adopted at Chateauroux. The mills are installed on the ground floor of a room 20 ft. high, and the screens are placed on a gallery above; the tobacco is brought by means of endless screens from the mills to the screens, and then return either to the mill, if the grain is too coarse, or to the sacks which receive the portion properly pulverized. During the whole of the process it is kept from contact with the air, and thus preserves all its aromatic properties; the dust does not circulate in the shop, and a large amount of waste is prevented. The mill consists of a fixed conical basin in which is a revolving cone of the same form, mounted on a vertical shaft, driven with a reciprocating movement. Both cones are fitted with projecting blades. A mill produces about 90 lbs. of ground tobacco per hour, and the cost of hand labor, which used to be about 5s. per 100 lbs., is now reduced to 2d. or 3d.

The ground tobacco called "rapé sec" is, after damping, laid in large wooden chambers, called the fermenting rooms, the capacity of each being from 25 to 30 tons. Here it remains for ten months, and during this time it is turned over two or three times in order to regulate and equalize the fermentation. In the modern establishments the process is performed automatically, so that the workmen are exposed to no inconvenience. On coming from these chambers, or rather from the last of these, which has a capacity equal to four or six of the others, where it remains about a month to mature, the finished snuff is filled into casks and sent off to depot. Until some time ago the packing was performed by workmen, who pressed the snuff into the barrels by their feet. To-day an ingenious mechanism is employed, of which a model is shown at the Exhibition, and by which the tobacco is distributed evenly in the cask, and compressed more regularly and at less cost than when a workman performed this double operation. The rammer has the same motion as the stamp in a quartz mill, and the cask, mounted on a turning plate, presents successively the various parts of its surface and becomes filled gradually. This system is, therefore, effective in producing a uniform compression in the whole volume, because, on account of the pulverulent and elastic nature of the material, the employment of a hydraulic press would compress only a very thin layer of the tobacco.

Such are the principles and processes of the manufacture of snuff, and considering how important are the elements of quantity and the time required, it will be easily understood how it is that the fabrication on a small scale does not succeed.

The manufacture of chewing tobacco comprises three distinct classes of products—the large spun rope tobacco, the smaller, or "pigtail," and the rolled "carrot" tobacco. The first kind is manufactured on hand-spinning machines by women, to whom the tobacco is delivered uncut; the juice of the tobacco is employed for damping, instead of such ingredients as molasses, licorice water, etc., which were formerly used. The damping is followed by compression under a hydraulic press, and subsequent drying in a current of heated air completes the preparation of this product.

The ordinary twist tobacco forming the second class is spun precisely like a rope. An ingenious arrangement of English origin is now employed, by which the work of making up the body forming the interior of the twist is performed. The "carrot" consists of five or six lengths of "twist" laid upon each other, and submitted to the action of a hydraulic press of special form, designed by one of the engineers of the Administration when the machinery at the Morlaix factory was remodeled.

We now come to smoking tobacco. Considerable doubt existed for a long period as to the possibility of manufacturing smoking tobacco with success on a very large scale, but, thanks to the elaboration of special machines, all the difficulties have been removed, and to-day we see one of the French factories, that of Lille, producing as much as 6,000 tons of it per annum. The preparation does not admit of any chemical reactions, and the manufacturer must above all seek to obtain by combinations a mixture which may satisfy the taste of the majority of the consumers. Every care must be taken to avoid fermentation and to insure the utmost preservation of the products. If, on the other hand, he operates only on special kinds, he has to make a careful selection of the leaves, and also to preserve in these the flavor and aroma peculiar to the brand. It is expedient in this fabrication to damp the leaves as little as possible, either with fresh or salted war, to incorporate with them only the quantity of water strictly necessary, to obtain the necessary softening, to dry the material with the greatest care, and never to collect it in masses before it is quite dry and cooled.

In tobaccos of very delicate aroma any baking process should be most carefully avoided. The foregoing indicates mostly the successive processes to which smoking tobacco is subjected. The damping is performed mechanically by means of the cylinder already described. The moistened leaves are left in masses during 24 hours, and the leaves, after having been well stretched, are then taken to be cut. The cutting machines employed at the French factories are on the guillotine pattern. The knife, carried on a vertical frame, moves in front of an opening, through which the cake of leaves passes, brought there between two endless bands, the rollers of which serve as compressors. Feed wheels, which can be easily adjusted, bring forward the cake at each stroke of the knife, thus fixing the advance of the endless bands. The knife makes about 110 strokes per minute, and the apparatus produces about 200 lbs. per hour, with a length of stroke of $\frac{1}{16}$ in. To remove from the tobacco its excess of strength, it is submitted to a temperature which should not exceed 212°. This operation, as injurious to the health of the workman as it would be, if not carefully conducted, to the quality of the product, was performed on iron plates heated by a fire, and later, on steam tables designed by Gay-Lussac. The workman, standing over the plate exposed to the warm current of air charged with the nicotine, and working incessantly to prevent the leaves from being burnt, was exposed to very grave inconvenience.

Thanks to the automatic torrifier of M. Rolland, this operation is effected to-day under conditions which leave nothing to be desired, so far as the health of the workman is concerned, and secures at the same time considerable economy in hand labor. The tobacco is introduced automatically into a heated iron horizontal cylinder turning slowly above a fire. A current of heated air passes through a double envelope covering the upper part of the cylinder, and entering it by openings, passes through the tobacco, carrying off the moisture, and escaping direct up a chimney. An ingenious arrangement of heat regulator controls the admission of the air under the fires in such a way as to maintain a constant temperature in the cylinder and envelope, and screws suitably placed within the cylinder determine the movement of the tobacco toward the exit, and prevent any prolonged contact with the heated sides. The capacity of this apparatus is about 1,100 lbs. per hour, and the cost of the process is reduced to one-third.

The tobacco now passes into a drying cylinder of a similar construction to that just described. Here it is cooled by the action of a brisk current of cold air, and is cleared from dust and even from débris. This cylinder can treat one ton of tobacco per hour, and its use allows of considerable economy in space, which the old open air driers required. After having been left *en masse* for some short time, the tobacco is ready for packing, an operation which is shown at the pavilion of the Champ de Mars, the machine at work there being a type of those actually in use throughout France. This machine is really a small hydraulic press, in which the pump body is fixed against a vertical cast-iron support, the upper extremity of which is curved over the machine, and carries the rammer and the pincers used to withdraw the funnel. The head of the piston carries a plate on which are mounted the moulds or forms of the packets, and into which is placed the mouth of the funnel previously covered with the paper wrapper. Finally, a cock of special form determines the movement of the compressor, and the discharge of the water after the work has been done. To produce the power, two or four pumps are employed, according to the number of machines to be driven, and an accumulator.

The actual packing requires the assistance of three workmen, one to weigh the tobacco, a second who puts the paper on the forms and gums on the labels, and a third who operates the machine and finishes the packet. The same machine is adopted for making up packets of all sizes by changing the moulds. These packets range between about 1 oz. and 12 ozs., and it can turn out 400 of the smaller and 200 of the larger per hour. The former are produced two at a time. After having been made up, all packages are tested for weight before they are issued from the factory, in order to be certain that the purchasers should receive their just weight, and that the amount should not be in excess. This process is performed with absolute exactness by means of an apparatus designed recently by M. Riorn, director, and a model is exhibited at the Champ de Mars. It consists essentially of a balance which, by the introduction of a system of valves, operated by the oscillating movement of the beam, sorts out the packages into three classes—those which are exact, those which are too heavy, and those under weight. The amount of error which is sufficient to throw out a packet is one four-hundredth. The packets are arranged by the workmen in a horizontal channel, the bottom of which consists of an endless belt, and are led to an inclined plane where they are stamped, and are afterward seized by claws which deposit them gently in the scale pan of the balance.

We can only indicate the general principle of the apparatus; to describe it in detail would exceed the scope of the present series of articles, and we will therefore make it the subject of a special notice.

The manufacture of cigars includes two series of operations, one the preparation of the materials, and the other the fabrication properly so called. This latter is performed entirely by hand in the French factories, despite the numerous trials of various machines that have been made. We may therefore pass briefly over that part of the work to dwell in detail on the preparation of the leaves, which is all important, since the value of the product depends upon it. It is necessary to combine a great number of different kinds of leaves to arrive at a good result, and when it is stated that the large proportion of foreign tobacco which used to be employed in the manufacture is now replaced by various home growths, it will be understood how much depends upon careful blending. This combination has been arrived at by macerating the leaves in tobacco juice. In this operation a mixture of soluble matters is arrived at, varying with the period of maceration and the richness of the juice employed.

This process, necessarily irregular when carried out empirically, is now performed with certainty and uniformity, since the conditions of the process have been carefully studied by M. Schlessing. The different phenomena which attend the contact of the juice and the tobacco have been ascertained by chemical analysis, and the results obtained have led to the establishment of a system of washing and saturating which produce with certainty the different flavors desired and the proper degree of combustility for the different leaves employed. The washing is executed with simplicity and certainty by means of an apparatus designed in 1868 by the director of the Chateauroux factory, and a working model of which is shown at the Champ de Mars. It consists of two groups each of six wooden vessels placed on the ground around the circumference of a circle, and of an iron tank in the center carried by a hydraulic elevator, which is divided by as many vertical partitions as there are wooden vessels.

The leaves, well stretched, are laid vertically in packages in the vessels, and they remain there during the whole of the operation. The juice, on the contrary, is shifted, and to do this the central vessel may be lowered when one of the macerated tubs is emptied, then by raising the central vessel the juice is discharged in the next tub, and so on. In this way the juice at first in No. 1 is ultimately deposited in No. 6, the most concentrated liquor being applied to the fresh leaves, while the most exhausted leaves receive supplementary juice, which varies according to the strength it is desired to impart to the tobacco. A battery of six tubs can treat 1,700 lbs. of leaves in twelve hours.

After being washed the tobacco passes under a hydraulic press, where almost all the excess of liquor is taken out, and thence they go to the torrifier, where they are dried and ready for fabrication.

Finally, we come to cigarettes, the manufacture of which has of late years so greatly extended that the French Government has commenced to replace hand work by machines, which have been gradually improved in their details, until at present they leave little to be desired. As in most machines containing many complicated movements, the various motions are obtained by cams, or rather by curved grooves of different forms, traced upon cylinders, in order to produce the movements of the various parts resting upon and articulated to them. At the Champ de Mars the various operations of cigarette making are exhibited to the public. The first process is the production of the paper tube, which is afterward filled and compressed. The machine comprises these three distinct features, all of which are very carefully worked out. It can produce 1,000 cigarettes per hour, while the most skilled workman can only make 150 in the same time. The Government factory also exhibits a hydraulic press for packing tobacco leaf and miscellaneous instruments of the laboratory. In addition, a large number of data are collected in the pavilion showing the consumption of tobacco in various countries and the revenue it brings.

Excepting in those countries where the industry is a Government monopoly, it is difficult to obtain exact data as to the total and individual consumption. In Europe, the monopoly is in force in eight different countries—Austria-Hungary, France, Italy, Spain, Portugal, Roumania, the Principality of Lichtenstein (Austria), and the Republic of St. Marin (Italy). The manufacture is under Government supervision in three States—England, Russia, and Turkey, and is entirely free in all others.

In Austria the consumption in 1876 was 31,614 tons, while in Hungary it was 15,000 tons. In France during the same year it was 31,435 tons, and 32,120 tons in 1877. In Italy during 1876 it was 17,200 tons. For these countries alone exact figures are available, but the estimated consumption in Germany was for 1876 about 80,000 tons. It is curious to note how the consumption varies from one month to another. Thus, taking the observations from two French and Italian factories, we find that they increase during the month of January, decrease in March, again to rise, but to fall to a minimum in July, to rise gradually to a maximum in December.

The following list shows the approximate average consumption for several different countries per head and per annum.

	lbs.
Austria	3·25
Hungary	1·91
France	1·96
Italy	1·55
Germany	4·00
England	1·32
Russia	1·32
United States	3·50

THE PARIS EXHIBITION.—THE ALGERIAN COURT.

The following table gives a financial statement of the tobacco industry for several countries:

Year.	Country.	Receipts.	Expenses.	Profits.
		£	£	£
1876	Austria	5,964,000	2,217,000	3,747,000
1870	Hungary	2,252,000	1,051,300	1,200,700
1876	Italy	5,362,120	1,672,600	3,689,520
1876	France	13,894,920	2,400,000	11,494,920

The amounts paid to revenues were as follows for four different nations during 1875–76:

	£
1875, England	7,569,720
1876, Germany	731,160
1875, Russia	1,711,200
1875, United States	8,716,000

Comparing the amounts realized by the taxation with the population, we find that the consumption of tobacco is attended with the following expense per head. Of course the figures are only approximate:

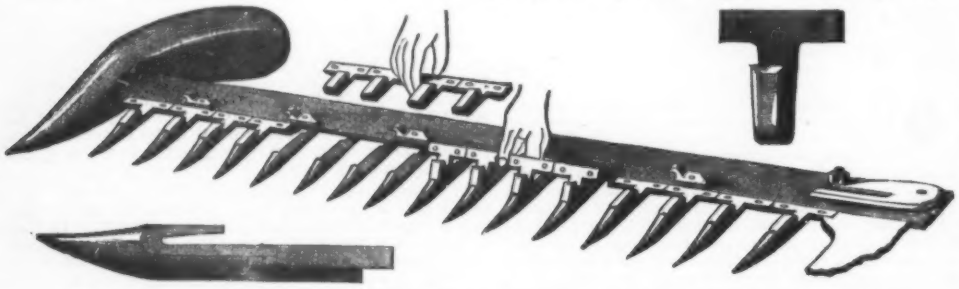
	d.
Austria-Hungary	57
France	84
Italy	52
England	56
Germany	4
Russia	5
United States	54

It is unfortunate that, from the absence of statistics of other countries, these results cannot be completed, but the little we have been able to give is at least sufficient to prove what we stated at the commencement of our first article, that the growth and fabrication of tobacco form one of the most important of modern industries.—*Engineering.*

CUTTING APPARATUS FOR REAPERS AT THE PARIS EXHIBITION.

In all reaping and mowing machines, without exception, the greatest wear and tear takes place at the cutter bar, not only on account of its rapid reciprocation, but also on account of the work it does in the process of cutting, and perhaps most of all because of the dust, grit, and small stones which unavoidably come in contact with the knives.

As the cutting action is not due to the knives only, but also, in a large measure, to the jaws through which they work (the action being scissors-like), it is clear that when either the one or the other becomes blunted, the power of the machine is greatly impaired. It has hitherto been customary to remedy this by sharpening the knives only, but Messrs. Burgess & Key, of England, have arranged the jaws so that they can be as easily and as perfectly sharpened as the knives themselves. The construction is clearly shown in the accompanying engraving. To the steel bar are riveted the forged-iron fingers, whose duty is only to separate the grass or corn, and on these fingers are laid the hardened steel jaws, riveted together in groups of four. Their bent or foremost ends are held down by the curved configuration of the fingers, and the T-shaped ends are kept down by the knives only, which in turn are secured by the usual keep-bar—this arrangement securing a close contact between the edges of the knives and of the jaws. As spare jaws can be kept, and as the arrangements for removing both them and the knives are extremely simple, no great time need be lost in replacing any of them which may have become blunted or damaged. The new cutting apparatus is a decided improvement in these now indispensable machines, and is shown by the inventors at the Paris Exhibition, together with their mowers and regulating reapers.—*Iron*



HARVESTER IMPROVEMENTS AT THE PARIS EXHIBITION.

COAL ASHES AS A CIVILIZER.

It is estimated that the city of Boston removes 100,000 barrels of coal ashes annually from the back yards of the dwelling houses, while large manufacturing and mechanical establishments cart away as much more. This immense quantity of ashes is generally used in "filling up" the waste places of the city to street level. A good part of the Back Bay territory, upon which now stands some of the finest public buildings and private residences in the city, is made from coal ashes. Coal ashes as a civilizer are but imperfectly appreciated. So far as the Back Bay territory is concerned, that property has grown in value from $8,000,000 to $40,000,000 in the past twenty-five years. If splendid residences—in fact two or three entire wards of a city—can be planted on coal ashes as a foundation, is there not some way in which we country people can utilize coal ashes upon our worn-out or heavy soils?

In discussions on old soils and what they need, it has often been remarked that coal ashes have a good deal of virtue. One great want of the old soils of New England generally, and Massachusetts particularly, is potash. Coal ashes certainly contain a trifle of this, the result of wood used in kindling. Again, careful observers claim that all heavy soils need ventilation, or "lightening up," to permit the free action of air. A Nantasket man who had land so poor it would not spindle corn applied coal ashes, two or three inches deep, mixed with a little yellow loam, then plowed and harrowed, and in three years the soil was so much renovated that he cut a ton and a half to the acre of the best clover. In another five-acre field, where he applied leached wood ashes liberally, not much advantage was noted the first year, but the next year the benefit was very perceptible, which increased annually five or six years, when the meadow was plowed up. In a part of the field barn-yard manure was used, which ceased to show much effect the third year, while the ashes were effective for many years.

A compost of three parts of muck to one of coal ashes was used in alternate strips on another field, by way of experiment, and sown with clover, rolled, but not harrowed. Wherever the compost was spread the clover germinated and developed handsomely, while the strips without the compost were barren. On Long Island the farmers send vessels to the State of Maine to bring mixed ashes from wood and coal by the cargo to enrich the famous vegetable gardens that supply the markets of New York. Perhaps it would be a benefit to our Maine friends were they to keep all their wood and coal ashes and apply it to their own lands.

In Cambridge a gardener last year covered his very sandy land with fine coal ashes, and on this he put a layer of loam, all of which he spaded in. In June last he had the finest-looking garden he has ever had. He thinks coal ashes did it.

Let us have the experience of such of our agricultural friends as have experimented with coal ashes, and determine, if possible, if they have any real value in improving the soil or adding to its vigor or fertility. I find, with all our experimenting and investigating, that hundreds of the same problems that were discussed years ago still remain unsolved.—*Boston Cultivator.*

THE ALGERIAN COURT.

THE Algerian Pavilion, in the grounds of the Trocadéro, is one of the handsomest structures of the Exhibition. Great care has been taken to avoid the exaggerated Oriental style to which many French architects are so greatly addicted, and the whole court has been planned after the model of various mosques and palaces at Tlemcen. The chief entrance, which is surmounted by a magnificent open-work dome, is copied from the well-known Mosque of Sidi-bou-Medina, while the side entrances are taken from the Mosque of Medersa. The interior is a rectangular court, with a garden in the center, filled with Algerian plants, and a marble fountain, while the surrounding arcades, characteristically ornamented with Moorish arabesque work, contain the exhibits forwarded by France's great African colony. The display is an exceedingly good one, and comprises all the products and manufactures of Algeria, from alimentary exhibits to carpets (there is one formed of 6,000 pieces for £20), fine trophies of indigenous woods, cork-wood, and cereals, which adorn the walls, to rose-water, weapons, and even a model of a vessel invented by an ingenious native (Mahmoud Cherab), which can be navigated in the teeth of the wind through the agency of the adverse breeze itself. There is a good show of scholastic appliances, such as books, maps and geological specimens, the mode of teaching being also amply illustrated; but the chief gem of the Exhibition is a little Moorish retreat at the far end of the pavilion, which, furnished in luxuriant Moorish style, with cozy divans and pictures, quaintly framed looking-glasses, and dimly lighted by soft-toned colored glass, makes one realize (particularly in this sultry weather) how it is that Orientals prefer the *dolce far niente*, easy-going tenor of their life to the hurry-scurry and stiff-backed-chair existence of the *Giaour*.—*London Graphic.*

FRENCH FOREST PAVILION.

THE French government has for many years past, like some governments of Germany, bestowed much care upon what is called "reboisement" of the highland districts, especially the mountain slopes of the Alps, the Vosges, and the Pyrenees. It is for want of similar provisions and legal restrictions that many upland districts in Spain and Italy, in Turkey, Greece and Syria, formerly producing vast stores of natural wealth, and maintaining large populations of industrious peasantry, have been converted into desolate scenes of arid rock and stagnant marsh, unfit for culture or pasture.

The Chief Commissioner of Forests in the French Republic is M. Gayffier, who has provided for the effective display of his administrative department in the Paris Exhibition. A wooden pavilion has been erected, of which we give an illustration, standing upon a raised bank planted with shrubs, and to be ascended by steps. The timbers of which this building consists are different sorts of native growth—the oak, the beech, the pine, the chestnut—so arranged as to contrast their diverse qualities; while the edifice is further adorned with trophies formed of the tools used by woodmen, with branches, roots, and pieces of the bark of trees. The interior is a long, wide and lofty hall, divided into open compartments, in which are displayed a collection of maps, plans and models of the forest reserves and plantations, specimens of botany and dendrology, and those of geology and entomology which in any way concern the business of forest conservation; models of machinery and of works designed to regulate the course of streams and rivers, so as to prevent inundations; carpenters' tools and wood-work of all kinds. This is one of the most interesting departments of the Exhibition.—*Illustrated London News.*

THE REPAIR OF THE BURNED MODELS AFTER THE PATENT OFFICE FIRE OF SEPTEMBER 24, 1877.

By GEORGE DUDLEY LAWSON.

AFTER the burned halls had been provided with a temporary roof the Examiners in the classes to which the burned models belonged set themselves down to the patient and discriminating task of culling out the bits and fragments and arranging them in groups of subjects of invention, and then, by comparison and knowledge, identifying them as to machine and patentee. Over a thousand tons of "chunks" and fragments stared them in the face; the iron beams of the roof had fallen on the heaps and smashed and bent the metal devices beneath into all conceivable shapes and diversities of contortion. Piece by piece the heaps were lifted, examined, compared with the drawings of models which the shape or purpose suggested as clews to identity, and either passed or laid aside for future inquiry.

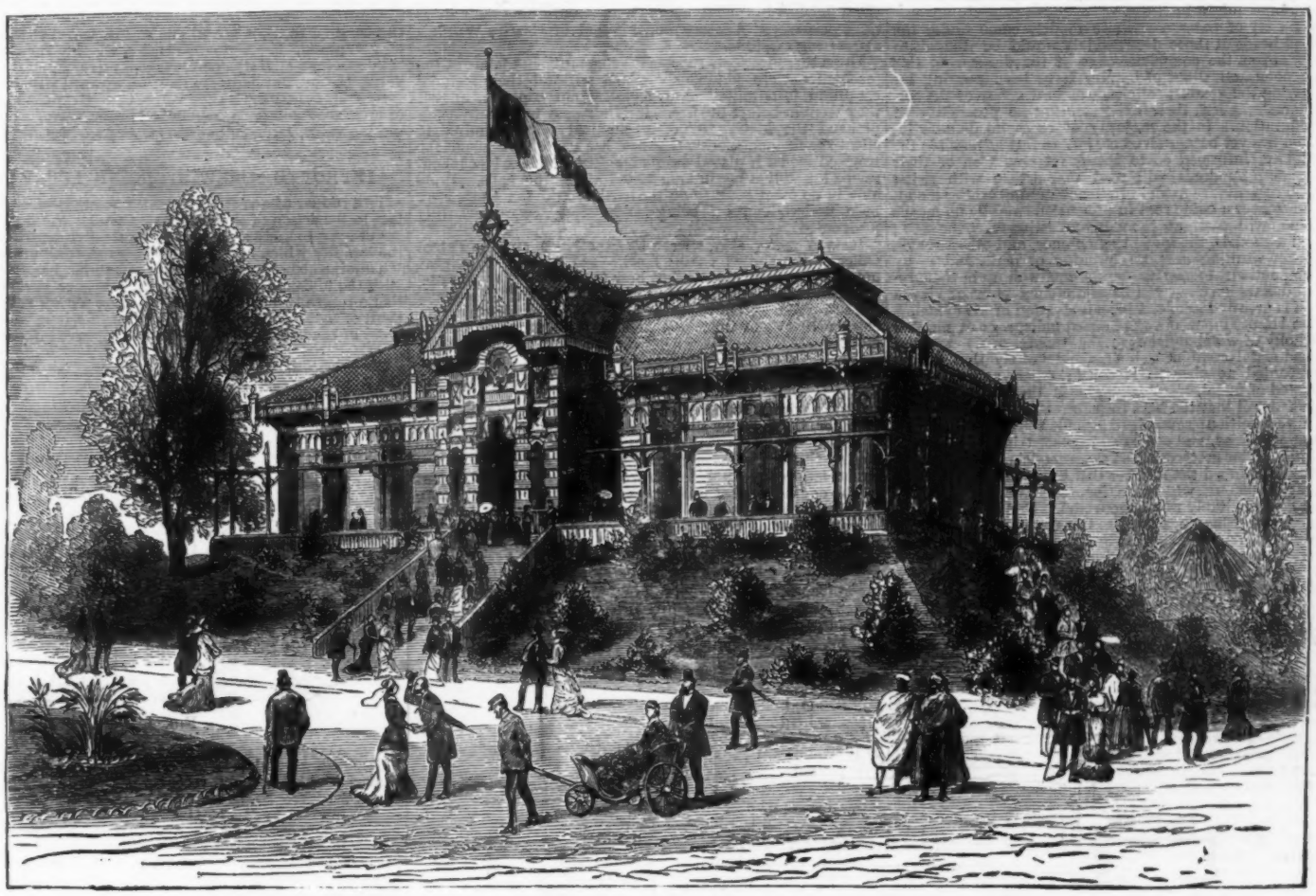
As soon as a model or a portion thereof was identified, a card bearing the serial patent number, the patentee's name, its designation, and date of patent was attached to it, and it was handed over to the custody of Mr. E. C. Ford, master mechanic of the office. He has been for several years in the Patent Office, and his experience and executive ability rendered him a most fitting man to take charge of the mechanical work of the repairs.

Day after day the work of identification progressed until it became apparent that, by effort and a moderate outlay of money, a large number, well up in the thousands, of those invaluable models could be saved. Apart from any consideration of the beauty and ingenuity of the models—apart from the stages they marked in the progress of invention and the triumph of American genius—this salvation was a matter of great moment; for the practice in vogue at the periods of the granting of most of the patents involved allowed considerable latitude and laxity in specifications and drawings, when the models fully and plainly elucidated the principles and working of the devices. To determine the exact status of a patent of invention and the claims in relation to it, both specification and model were absolutely necessary. Latterly, however, the rule has obtained that the specification must be an entirety and the model merely an exhibit, so to speak. Many, therefore, of the imperiled models were essential parts of the patent proceedings, and on their restoration depended the decisive explanation of the patent. And the fire left the models of the West and North halls in a state that made the twelve labors of Hercules a modern fact in the way of identification and restoration.

The northerly end of the East Hall, devoted principally to intricate machines of household and textile fabrics varieties, although saved from the flames, was thrown into utter confusion, and much damage was wrought. To extinguish the fire, the hose from the fire-engine was passed through this hall, along the Seventh street side, and here the damage caused by the heat driven in from the burning halls was supplemented by the clouds of steam which arose from the water poured on the flames, and from the bursts of the water itself. At the north end of this hall every case was broken, smashed, and dislocated to an extent that may be appreciated when it is stated that over $400 has been paid for the glazing alone of these cases. The models here were for the most part of sewing machines, looms, knitting and netting machines, and kindred mechanisms, composed of hundreds and thousands of parts, delicate, fragile, and polished. On the shining surfaces the water fell, and into the minutest interstices and closest joints and journals the steam penetrated, rusting the metal, stiffening the joints, and threatening sudden and inevitable destruction. The difficulties which met the officers on whom the labor and responsibility of rescue and restoration fell may be partially appreciated by imagining the task of repairing a diminutive fac-simile of a leather sewing machine; a power-loom, with harness, heads, and every part complete; or a knitter, bristling with tiny pieces; the whole cemented together by heat, rust, and dust. These little machines require as tender handling as the finest watch; for, in almost every instance, the patent covers some minute portion or portions, or some peculiarity of action, resulting from the combination of a vast number of little devices, to all of which every piece in its entirety of shape and function is necessary. In fact, the injury sustained by and in this hall could only be exceeded by that of the total destruction as experienced in the West and North halls. The work here was under the immediate supervision of Mr. A. S. Richmond.

The fire was hardly subdued before measures were on foot to rescue these delicate models from their peril of rust and decay, and a corps of skilled artisans were immediately put on the work. Congress appropriated $45,000 for the necessary repairs, and a plan of economical and rapid restoration was formulated under the temporary roof of the G street, or north wing; long lines of workbenches were placed and fitted with tools; forges were erected, and acid-baths constructed; turning lathes and places for painters provided, and one hundred and fifty mechanics, comprising turners, wheelwrights, locksmiths, watchmakers, mathematical instrument makers, tool and model makers, and other workers in wood and metal, were set at work, the first move having been made to locate classes and gain a clew to the conglomerate of fragments by identifying the contents of the cases that stood on the spots occupied by the respective heaps. The floors of the model rooms are all tiled and incombustible, so that comparatively little confusion was effected by the falling in of the roof, compared to that following a breaking through from story to story, though the melting copper added an element of calamity to the disaster by fusing and cementing the metal on which it poured into almost indistinguishable masses. But the patience and skill of the Examiners having cognizance of the groups and classes of inventions resolved the chaos and disorder into something like system. The careful sorting of the heaps—every bit of metal examined and every trace scanned for identity—resulted in setting aside numerous metal models unbroken, though sadly corroded and distorted. Then disjointed sections were compared and whole machines heaped together. The Examiners' assistants attached to each model or fragment, as it was identified, a card or tag bearing the name of the inventor, etc., and known as "the identification card." Having reached this point the model was taken to the Desk of Record of Repairs, where its identification and condition were entered in a book. These books were twenty-four in number, one for each master mechanic on the line; the master mechanic turned the model over to his assistants or helpers, who performed the rougher part of the work, such as freeing the metal from its scales of oxidation, and the corrosion of fire and acid; and in most instances the "helpers" took the model apart. The metal was first brushed vigorously with a steel wire brush, an excellent instrument for the performance of this work. From the scratch-brush the models were transferred to the sulphuric acid bath, where the operation of cleansing was completed and the model dried in an adjoining box of sawdust.

The first duty of the "helper" was to oil the model thoroughly, and with care to start screws and parts rusted together. Then followed the operations of polishing, oiling, setting up and painting. After a model was repaired to the extent of privilege it was returned to the recording clerks, where the entry of final record was made. These records read as follows:



PAVILION OF THE FRENCH FOREST CONSERVATORS

Identification: A. S. Gear, Moulding Machine, No. 4,885. Reissued April 30th, 1872.

Before Repair: Material—brass and iron. Condition—burnt and rusted and the following parts missing: the shafts, *h, k;* frame, *i;* pulleys, *l, m, n;* cutter, *o;* guide roller, *p;* table, *x;* work, *y;* pattern, *z;* dogs and clamp-screws; handles, *g, g.*

Repaired: Taken apart and cleaned; a new wooden table was made to replace the burnt one.

After repair: Condition—the remaining parts of this model are in good condition, but many valuable parts covered by the claims are missing.

The workmen were furnished with the original drawing in each case or with the photolithographic reproduction thereof, and the specifications of each patent as originally filed were scrupulously studied, in order to obviate any danger of altering, mutilating or obscuring the design, or the claims of the patentee, in the repair of the model. Implicit instructions were given the machinists that in no case were they to introduce or separate any part or portion or depart, in any form, from the specifications, and an untiring watch was kept by the officers in charge, over the enforcement of these orders.

To the unskilled observer, the task of untangling the metal snarl, taking apart the jammed and corroded machine, starting screws and releasing trains of wheels all oxidized by heat and soldered together by the copper from the roof would have seemed hopeless, and in many cases an impossible one. But the necessity was great and the magnitude of the interests involved stimulated endeavor; patience and skill did the rest. Those heaps of distorted metal contained evidence as vital as those of deeds on record, and their restoration included the settlement of claims and disputes, and the prevention of much vexatious litigation that rivalry or self interest might institute.

The anxiety of patentees whose models came under the published heads of those destroyed it would be difficult to portray. From the commencement of the disaster to this writing, communications of inquiry have been pouring in, all betraying the greatest solicitude as to the fate of the correspondents' models, their existence or the possibility of their restoration. In the majority of cases no definite information has yet been arrived at, but as fast as possible the patentees are informed as to the exact condition of their models, and hundreds will read this article with rising hopes. The ordinary model of a machine for turning metal, though not over a cubic foot in dimensions and by no means completed, will cost, at a moderate estimate, over $30; while some models, those of pin machines, and others which depend for working on a vast number of parts and many reciprocal actions, not unfrequently cost well up in the hundreds of dollars, so that even from a money point of view a patentee is greatly interested in the salvation of his model.

Of the 114,000 models in the burned halls, a great number were wholly of wood and left not a trace; many were of wood and metal combined, but so indefinitely that the remains afforded no clew to identity; others again, though constructed of metal, were so slight in their nature and so barren of detail that the heat transformed and twisted them beyond recognition; several thousands were models of rejected applications, and others were placed in the halls for exhibition. The subtraction of these models from the number affected reduced the number that it was desirable to save to about 90,000, of which the first estimate indicated but two per cent. as likely to be recovered. Proceeding on this estimate, Hon. Ellis Spear sent to Congress a request for an appropriation, on which action was taken, and the sum of $45,000 granted. The preparation of the North Hall for a machine shop and the purchase of tools and materials consumed about $5,000 of this amount, and the balance sufficed to keep the work busily along until April 1st, when, the money having been nearly expended, work was suspended. The whole force was discharged except the clerks of record of repairs, whose duties being of the nature of preserving evidence, exercised a care and circumspection which prolonged their labors beyond the term of the current work of repairs.

On the 1st day of April there had been identified and put into as good condition as the restrictions thrown around the repair permitted the almost incredible number of 17,313 models, and there had been identified, but not repaired, over 1,000 more; while there were in plain sight 10,000 more the identification of which was merely a question of time and expense. This exhibit brings up the estimate of restoration from two to thirty per cent., a result due to the intelligence of the officials concerned in the work.

The announcement of the beginning of the work of repair brought regiments and platoons of men seeking employment, although it was well known that it was to be a temporary affair. Mr. J. W. Babsen, appointment clerk of the Patent Office, was overwhelmed with applications. Every State was represented by a strong delegation, and even the territories had their representations; every man was backed by "the member from his district," and not a few commanded the influence of Senators, Cabinet Ministers, and even of the President himself. The task of selecting a force from this army of applicants was of most delicate nature, for selection gave little satisfaction, while refusal entailed murmurs and complaints. The pay was necessarily very low, owing to the small appropriation and the lengthening time of the work as the number of identified models swelled. Master mechanics received $2.50 a day; helpers, $2.00; laborers, $1.50, and common laborers, $1.00. After the cessation of work hundreds of men watched every chance of renewal, and the slightest rumor of another appropriation reopened the flood-gates of applications, and another irruption of men frantic for employment. Never before in the experience of Washington were there so many men in the city out of work, so much suffering among the working classes, or so much work actually requiring to be done. The Patent Office has a credit of over $1,100,000 in money, its surplus deposited in the Treasury of the United States, and yet for months this, one of the most costly, expensive, and important of public buildings, has been allowed to remain unroofed, a prey to the elements and a standing rebuke to the parsimonious policy which seems to actuate Congressional action. On the work of rebuilding five hundred men could be profitably employed for months, and in continuing the work of repair of models two hundred more could be equally profitably employed.

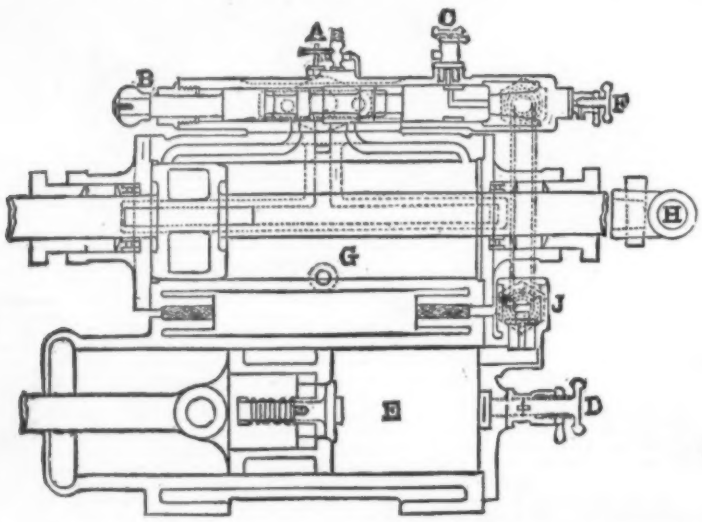
Among the more complicated and costly models repaired are included Benoit's file-making machine; B. A. Mason's improvement in machinery for shaving, nicking, and pointing wood-screw blanks—an intricate and highly-finished model; S. D. Sheldon's machine for serrating sickle sections for harvesters; John J. Howe's improvement in machinery for making pins, and Moses Allen's planing machine—all of them finished in the highest style and performing their functions perfectly. Another model is that of Charles Wilson's excavating machine.

Upon these intricate models the ingenuity and labor of the mechanics were judiciously expended, and their restored condition is admitted to be equal, if not superior, to that they were in before the fire. It is an easy matter to comprehend the high grade of mechanical genius required to effect the metamorphosis that has been wrought when the restored model is placed beside one just from the blackened, rusted heaps that lay in long vistas along the halls. Probably in no other country on the earth would the work have been undertaken, or, being undertaken, so successfully prosecuted.

It is a *mot* that we learn by experience, and the Patent Office of the United States has learned by this experience not how to repair models, but how to prevent their destruction; and if precaution and diligence go for anything under the sun, there will never again be occasion for writing articles on the Patent Office fire and the restoration of burned models.

IMPROVED MARINE ENGINE GOVERNOR.

This governor consists of three main parts, viz.:—steam cylinder, G, its piston slide valve, B, and an air pump, E, all bolted together by a bracket, to any convenient part of the engine. The piston of the air pump is worked by its rod connected to any convenient revolving or reciprocating part of the engine, so that it compresses the air in a small chamber between the pump and the piston valve, or it can be driven by a small eccentric direct off the crank shaft. The piston valve being made differential, and the steam being admitted in the center, it has the tendency to keep the piston valve, B, against the close end of its casing, the regulating valve, D, at the close end of the air pump, being adjusted at a part where the pressure of air and the steam balances the piston valve. The slightest movement of the engine to increase the speed it has been regulated for, forces the piston valve to the opposite end of the casing, thereby admitting the steam to the other end of the cylinder piston, the rod, H, of which is attached to the lever in connection with the throttle valve. The balance wheel, F, is for adjusting the action of the piston valve to long or short seas.



RANKIN'S IMPROVED MARINE ENGINE GOVERNOR.

In the engraving A is the steam valve; B, piston valve; C, escape valve; D, regulating valve; E, air pump; F, balance valve; G, steam cylinder; H, piston rod; J, retention valve.

The Air Pump.—This may be either single-acting or double-acting, but the patentee prefers the former, because he finds that in its practical application it is as sensitive as it is desirable to have it. The plunger of the air pump is constructed with a valve on its inner end, so that on the outward stroke of the pump the valve opens and the chamber fills with air, the valve being closed during the return stroke either by a light spring or by the pressure of the air inside the chamber. A connection is made by means of a small tube between the air pump and the end of the piston-valve casing.

The steam cylinder does not differ in any important feature from any other ordinary steam cylinder. It is provided with stuffing boxes at both ends through which the piston rod passes, and on either end of which the joint is fixed for connecting the rod which is attached to the lever of the throttle valve.

The piston slide valve casing is provided with branches for steam and exhaust pipes; and there is likewise the connecting tube already referred to as extending from the close end of the air pump.

The advantages of this governor are its sensitiveness, quickness, and certainty of action, few and light and balanced parts, and hence little or no tear and wear; thereby insuring great durability and little liability to derangement or occasion for repair. It is most compact and accessible in its parts, easily managed, and can be set in a few seconds by the valves D and F to suit any speed at which the engine is desired to be driven.

The various parts of this governor are so nicely adjusted that the slightest tendency of the engine to run away, or to exceed the speed for which it has been regulated, at once forces the piston valve to the opposite end of the casing. The steam is then admitted into the opposite end of the cylinder, and the throttle valve is closed again immediately. When the engine regains its mean speed, the piston valve regains its former position, and the throttle valve opens, and continues open until the engine again attempts to run away. Though specially designed for compound marine engines, Rankin's governor is also suitable for rolling mill or other engines whose powers are frequently varying and require a quick and certain acting governor.

For regulating this governor, open the steam valve, A, at the same time working out and in piston valve, B, until it is seen that there is sufficient steam to work throttle valve, then half shut escape valve, C, adjust regulating valve, D, until piston-valve, B, is forced out half its travel at each stroke of air pump, E—engine working all the time at speed wanted—then slightly open balance valve, F, so that piston valve, B, does not hang too long on upward stroke.

In short seas, keep escape valve, C, well shut, and for long or cross seas well open, regulating piston valve, B, with regulating valve, D, to suit.—*Marine Engineering News.*

IMPROVED SCREW STEERING APPARATUS.

The rudder of a vessel frequently presents so small a surface to the action of the medium in which she floats that it is not uncommonly a difficult thing to alter her course with the rapidity which is desirable. It is not at all unlikely that the diminished size of the modern rudder has much to do with the indisposition of a vessel to answer her helm, and that a return to an old plan of having a deep rudder, one-third or half out of water, or the use of a long rudder, like those of the old Rhine boats, might improve matters. But

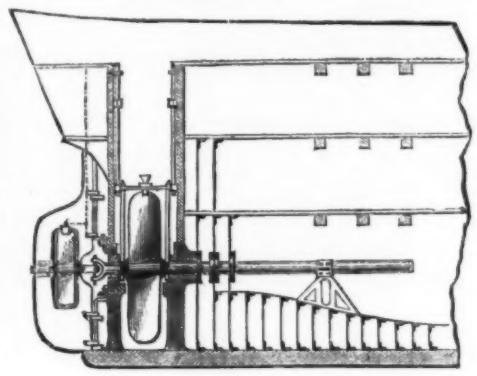


Fig. 1.

if the smaller rudder is to be retained, it may well be improved, and has, in fact, received not a little attention from inventors. We lately described a very scientific form of rudder devised by Mr. C. G. Gumpel, and now bring under our readers' notice another device, on an entirely different principle, the result of many painstaking experiments by Mr. J. J. Kunstadter, of Walbrook. This consists of a screw propeller, mounted in an opening in the rudder blade, as shown by our illustration. This screw may be supplementary to the ordinary propeller, in which case it must be only

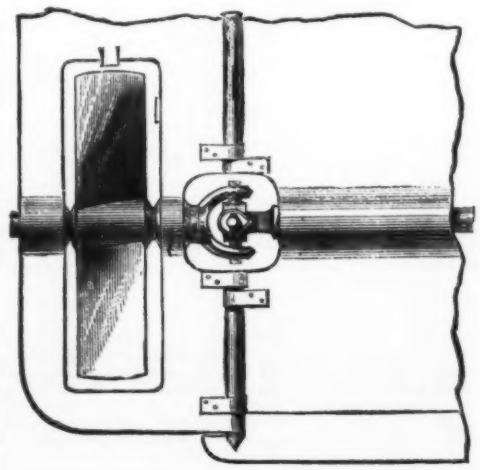


Fig. 2.

about seven-tenths its diameter, and it may be mounted aft of the rudder-blade instead of within it. Or in the case of small vessels, launches, etc., it may be the sole means of propulsion. The manner of connection with the screw-shaft is obviously by a universal joint, Hook's form being found most satisfactory, though a ball and socket joint or round-faced bevel-gearing may be employed. In the form of Hook's joint, preferred by the inventor, great pains have been spent

to keep the line of strain as far as possible in the exact center of the shafting. Of course the inequality of action inherent to the joint cannot be wholly eliminated, but it is believed to be reduced to a minimum, while the pieces of which the joint is made are so contrived as to be easily replaceable in case of injury. Fig. 3 gives details which show that the four pins upon which the strain chiefly comes are screwed home and fixed by a center-pin, so that even if they should twist a little they will be held the tighter.

The practical performance of this rudder screw appears to be very good. It has been fitted to a small steam launch, which had been condemned by the owner for refusal to answer her helm, but which has quite regained her character under Mr. Kunstadter's care. With this launch a number of experiments have been conducted on the Thames by representatives of the Admiralty, the Board of Trade and of several foreign governments. Our own government is about to make further trials with a larger ship, and we believe that a torpedo launch is to be included in the experiment. On a

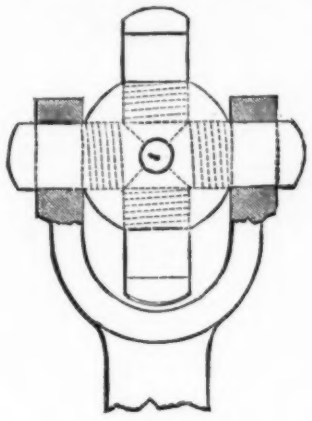


FIG. 3.

recent occasion, when we timed the trials, we found that a complete circle of the launch was effected in 55 seconds on the port and 61 seconds on the starboard side, the vessel being turned while running at full speed. Starting from stop, the circle took 66 seconds. These are good results, and fully justify the hope that this device may be useful in, at any rate, the smaller vessels of our service. Of its applicability to larger ships we have some doubts, though it is but right to say that naval officers of experience think otherwise. In concluding we may note that this is by no means the first case wherein a rudder-screw has been suggested, but in no other that we know of has the notion been put into actual practice.—*Iron.*

WEST'S REVERSING GEAR.

WEST'S six-cylinder engine was fully described and illustrated in a former number of this journal (SUPPLEMENT No. 59, Feb. 17, 1877), where the peculiarities of its construction are plainly shown. This engine has six small cylinders arranged in a ring, which operate an oscillating disk plate at the back end of the cylinder.

The uniform rolling motion of this plate is then communicated by means of a perpendicular axis oscillating at its base on a ball and socket joint, and revolving at its upper end around a shaft which is fitted with a crank, to secure the end of this rocking axis and to transmit the motion.

The successive action of these six cylinders is secured by an alternate opening of steam ports and connection of same to the exhaust passage and pipe. The steam-chest is a circular chamber at the front end, extending over the surface of the whole six cylinders, which have suitable half-moon passages into their upper ends. In this steam-chest revolves a double hollow ring, whose parts are kept apart by the internal steam-pressure, which thus causes the two rings to make a steam-joint on both the lower and upper faces. The valve is thus in equilibrium, and therefore moves with the least friction, and is exceptionally easy to reverse.

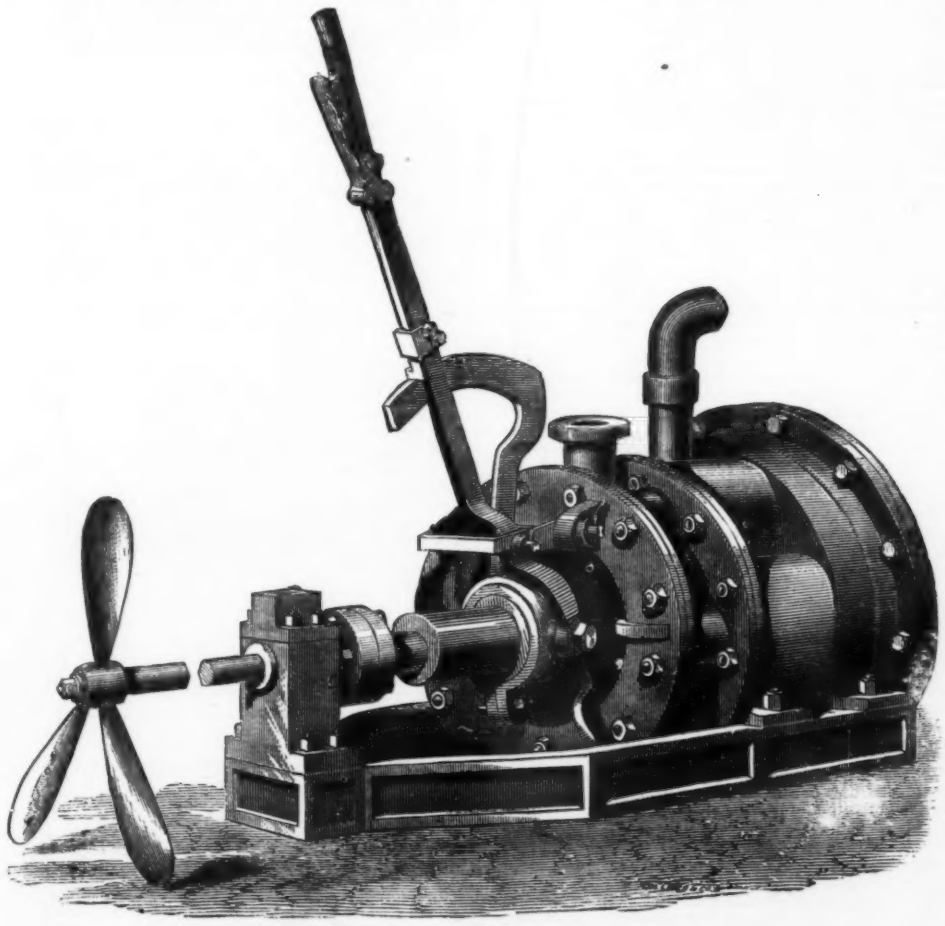
This hollow ring valve is moved, with an all-round polishing slide motion, by an eccentric keyed on to the shaft. The rings are not, however, fixed to the eccentric and need not thus revolve; but the eccentric is a loose fit in the rings, and thus pushes them over each steam-port in succession, following the motion of the eccentric. This gives the necessary action with the least motion of the ring valve, and therefore with the least friction. When the ring valve is drawn back from the ports, the live steam is admitted in succession to the six cylinders, and when the valve is thrust forward over the ports these latter are thus put into communication with the exhaust chamber, which is in the interior of the valve.

The engine, as described in our former number, was simply fitted to revolve in a single direction of rotation for ordinary mill or driving purposes; but undoubtedly one of the most advantageous applications of such an engine would be for driving the screw of a launch or other steamboat. The advantages of such an engine would be obvious. The cylinders are always thrusting, and therefore without alternate tension and thrust, as is the case with a reciprocating engine. This gives a very steady and noiseless motion of rotation to the shaft at a very high speed, and is therefore exceptionally useful for a launch engine. In fact, we have seen reports from those who have used this engine for launch work, and they state that the boat seems to glide along without pulsation. The exhaust blasts are also so small and so continuous that no puff is heard.

For such a purpose it is necessary that the six-cylinder engine shall be promptly and rapidly reversible; and this end is attained by means of the reversing gear we illustrate this week. The reversing action will be obtained if the position of the eccentric be reversed, for then the order of opening and closing of the ports to the cylinders is reversed. This reversal of the eccentric is produced in a very ready and simple manner, as may be seen from our illustration.

The eccentric is keyed on to a loose cast-iron sleeve, which surrounds the revolving shaft, and is brought outside the cylinder through the stuffing box at the end. This sleeve is coupled after it leaves the stuffing box with a longer sleeve, so that this outside sleeve makes a coupling between the eccentric sleeve and another one fixed by a set bolt to the revolving shaft. The eccentric sleeve is driven by the coupling box from the fixed sleeve on the shaft. The means of driving is through a stud in the sliding coupling collar. The stud runs with rollers in slots, of which one is straight and the other is spiral. The position of the eccentric sleeve, compared with the shaft and fixed sleeve, depends upon the position of the intermediate sliding collar carrying the stud. For, as this latter moves backward and forward in the direction of the length of the shaft, it causes the eccentric sleeve to rotate relatively to the shaft or fixed sleeve, owing to the spiral groove. As this rotates relatively to the shaft, it alters the position of the eccentric relatively to the shaft.

The reversing lever oscillates on a hanging center-pin fixed by a link from the cylinder-cover, with a quadrant bar passing through it, and the open jaw of the lever embraces a collar by two side pins. This collar is necessary to allow the sleeves to rotate with the shaft inside the collar, which remains stationary with the jaw of the lever. The loose coupling collar carries two rollers on its stud, which run respectively in the straight and spiral grooves. As the lever is pulled over the roller-stud is made to travel in the two grooves, and the straight groove is thus made at once to correspond to the position of the spiral groove at whichever end the stud may be. The eccentric sleeve is thus very easily and promptly reversed.—*Iron.*



WEST'S REVERSING GEAR.

ENGINEERING IN PERU.

MR. W. H. CILLEY, an American engineer, who was connected with Mr. Meiggs during the last eighteen years of his life, and who conducted all his engineering work, has been giving to the San Francisco *Call* an account of the engineering operations in progress in Peru. The work originally undertaken by Mr. Meiggs for the Peruvian Government comprised the building of several lines of railway that were considered military and political necessities, viz., the Callao, Lima, and Oroya, and the Oroya and Cerro de Pasco railroads, crossing the Andes to the east; the Chimbote and Huarez Railroad, extending to the north along the westerly slope of the Andes; the Mollendo and Arequipa and the Arequipa and Puno roads, extending north and eastward and penetrating several hundred miles into the interior, and the Juliaca and Cuzco road, all forming a network of rail that puts Lima into direct communication with all portions of the republic. The contracts were made with a liberality on the part of the Government that would have done credit to more prosperous nations. The work was pushed forward with a rapidity and thoroughness unexampled in the history of engineering, when the tremendous obstacles met with in the formation of the country are taken into consideration. Scientific and railroad men everywhere watched the progress of the work in astonishment, as all their theories and predictions of failure were overthrown one after another. Political and physical disturbances, revolutions, and earthquakes retarded the work at intervals, but it was never abandoned by Mr. Meiggs and his colleagues. A little over a year ago the financial depression that had affected other nations reached Peru, and a panic ensued that threatened to put a stop to the work, and the Government scrip issued in payment on the contracts depreciated to about 40 per cent. of its face value. It was feared by many in this country that Mr. Meiggs would be unable to withstand the shock, and that the work would necessarily be abandoned for years to come; but the panic subsided when it became evident that there was no real cause for it, and the nation began to recover slowly from its effects. Both the Government and Mr. Meiggs were determined that the work should proceed, and the latter directed attention to the Cerro de Pasco mines, long since abandoned, in whose depth lay imprisoned the means for finishing the great undertaking, awaiting only the introduction of modern machinery to yield up their great treasures. The Government authorized Mr. Meiggs or any company that might represent him to issue bonds to the amount of £2,400,000 sterling, bearing gold interest at 7 per cent., the principal and interest being guaranteed by the Republic of Peru, and the means for paying interest and principal were placed directly in the hands of Mr. Meiggs.

All the mineral lands belonging to the Government in the Cerro de Pasco district were ceded absolutely to Mr. Meiggs, and persons owning and working claims in that district were allowed the option of continuing their work and paying Mr. Meiggs 30 per cent. of the ore taken out or relinquishing their claims to him and receiving 20 per cent. royalty. There were fifty-three legal claims of 100 meters by 300 meters, and nearly all of the owners preferred to give them up to Mr. Meiggs and receive the 20 per cent. of ore extracted. The death of Mr. Meiggs last year did not interfere with this arrangement, as the contract held good with any persons who might succeed him.

The building of the Oroya Railway, from the sea coast over the summit of the Andes, through the ruggedest country on the earth, is the most stupendous engineering feat of the age. Unlike the overland road in the United States, which reaches its greatest elevation in the Rocky Mountains by almost imperceptible gradients, the Peruvian highway in the clouds begins to climb the steep sides of the Andes at grades that are startling in their boldness and precipitousness. The heaviest grade on the line is 4 per cent., or 211 feet to the mile, and on some of these grades there are curves of 373 feet radius, or in the metric system, which is used exclusively in this work, 115 meters. Some of the curves on the easier grades are much sharper even than this. The road winds up the side of the mountain in a zigzag and oftentimes almost circular path, and at one point there are two tunnels through the side of the peak, one directly above the other, in the same lateral direction. The rarefied atmosphere at the great elevation reached on the summit presented many new features in railroading, as a locomotive had never before been worked at these heights. It was supposed by engineers generally that it would be impossible to keep up steam above 8,000 or 10,000 feet, and many men eminent in their profession in Europe wrote to Peru asking how this difficulty would be met. The problem solved itself in a very simple manner as soon as the test was made. Hydrogen is necessary for combustion, and, of course, in a rarefied atmosphere, the amount of hydrogen is less than in the same bulk of air where the density is greater. At great elevations it was merely necessary to introduce into the furnace a greater quantity of air in a given time than at the sea level, and the simple operation of opening the dampers wider accomplished this result.

The world-famous Cerro de Pasco silver mines are at the intersection of two immense mineral lodes in the Province of Junin, one running through the Cordilleras in a northeasterly direction, and the other through a spur of the same range with a northwesterly trend. The ore body averages seven-eighths of a mile wide by one mile and a half in length, is of irregular shape and unknown depth. The mining done by the Spaniards and Peruvians has all been in the surface deposit, and really amounts to nothing more than prospecting in these days. Their deepest shaft is only 360 feet below the surface, and has been sunk through the decomposed rock forming the surface ore. The shafts vary in actual depth from the surface, which is irregular, but they are all sunk to the same water level. The unstable character of the formation in which these shafts were worked caused many accidents, and working in the old Spanish mines of Cerro de Pasco was a decidedly dangerous occupation. The surface to-day is honeycombed with deep and extensive sinks or *tajos*, where the mines have fallen in, and many a miner's bones are intombed in these great sepulchers. The most terrible of these accidents occurred in 1710, when 300 persons were buried alive beneath the roof of a mine through the giving way of the supporting timbers. All of the top deposit in this district of a square mile is what miners call pay dirt—that is, it is decomposed rock containing free-milling ore that averages $40 to $45 per ton. The ore re-

maining in this surface deposit of decomposed rock is sufficient in quantity to run all the mills in Nevada at their full capacity for 150 years.

Below the depths to which the Spanish miners worked their shafts the diamond drill has been used to prospect the mines. The rock is hard and uniform in character, averaging about $165 to the ton in assaying. Pockets are frequently struck yielding ore that contains from 50 to 80 per cent. of silver.

Professor Raimondi, who has conducted scientific explorations in Peru for many years, is of the opinion that the coal fields of the Huaraz Valley will prove to be the most extensive in the world. The coal is principally semi-anthracite, although cannel and bituminous coal have been found in considerable quantities in the interior.

THE MANUFACTURE OF WROUGHT-IRON PIPE.

The sheet iron used for making boiler tubes, says the *Revue Universelle*, is either charcoal plate or a superior quality of coke iron. For locomotive boiler flues, only charcoal iron of the very best quality or soft Bessemer steel is employed. Thus, for instance, the Düsseldorf mills use only Swedish Bessemer steel. It is of the utmost importance that the sheet is not cold short, as the finished tubes are subjected to hydraulic pressure, and must be able to undergo the test of being bent double cold. A slight quantity of phosphorus favorably affects welding. The thickness of the sheet is, on the average, 12 to 15 per cent. greater than that of the pipe, as a loss takes place in reheating, and the thickness is decreased by drawing in the train. The length of the sheets should be greater by 8 to 12 inches than that of the pipe, and their width exceed the external circumference of the latter by almost half an inch, in order to allow for the lapping of the edges in welding. The piles

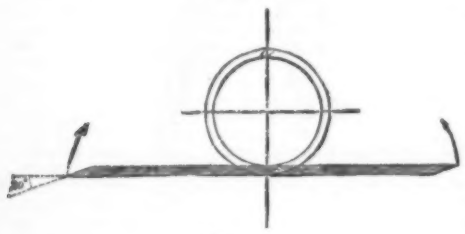


Fig. 1.

for the manufacture of the sheet are roughly trimmed. The width of the sheet cannot be more than 20 to 32 inches. If it were increased, the thickness of the sheet would not be uniform, which in welding would entail serious difficulty. If, on the other hand, the width were too much diminished, the sheet would not come from the rolling mill straight, causing too great an amount of scrap. It is not advisable to avoid the latter too scrupulously, because frequently the edge of the sheet is irregular. The sheets are not annealed, and it is best, in order to remove scales, to sprinkle them with water during their last passage through the rolling

Fig. 2.

mill. They should be sorted with the greatest care, as flaws grow worse during the manufacture and occasion waste.

BENDING THE SHEETS.

The sheets are cut to correct dimensions by circular saws; their edges should be straight and parallel. Then their long sides are so sloped that the planes of the edge thus formed make an angle of 20° to 25° (see Fig. 1). This is effected by planes, one of which is above and the other below the sheet, which is drawn horizontally on a bench. The drawing

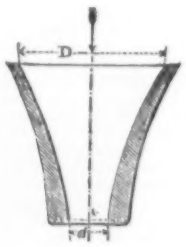


Fig. 3

bench is composed of an endless chain, supported by two rollers about 20 feet apart. It moves a small carriage which carries a pair of tongs, the lower jaw of which is immovable. The end of the upper jaw is raised by an eccentric lever, one of the arms of which is attached to the endless chain. One of the ends of the sheet is then rolled up, the exterior diameter of the portion turned being a trifle smaller than that of the pipe (see Fig. 2). This operation is performed on a mandrel, which is necessary, however, for pipe of large diameter only. The sheet is next placed in a reheating furnace and brought to cherry redness uniformly for its whole length by a smoking reducing flame. The hearth of these reverberatory furnaces, the type usually chosen, is slightly inclined toward the working door. The flame, after having passed over the entire length of the hearth, which is generally 20 feet long, enters the main flue either by one large opening in the hearth or by flues in the side walls. The turned end of the sheets is placed near the working door. Before the furnace, as near it as possible, is the train for the finishing rolling of the sheets. The most important part of the train is a cast iron gauge, the inner surface of which is turned in a gradually widening form. The smaller diameter, *d*, Fig. 3, is equal to the exterior diameter of the tube, the larger diameter, D, being three and a half times as large. The larger opening of the gauge is directed toward the working door, its height above the level of the floor being equal to that of the door. As soon as the sheet has reached the required temperature it is withdrawn from the furnace and the turned end is introduced into the gauge. That part which protudes is seized by the tongs of a drawing bench, the movement of which forces the sheet to pass slowly through the gauge. The tube so formed is smoothed with wooden mallets, and is then taken to the heating furnace, to be heated to a welding temperature.

WELDING THE TUBE.

The construction of the heating furnace and its management are the most difficult parts of the manufacture. The tube must be heated uniformly for its whole length to the welding temperature, and it must be withdrawn at once as soon as that temperature has been reached, otherwise the iron is burnt and becomes crystalline and brittle. The hearth is 20 feet long and 1½ foot wide. It is made of quartz, in pieces at least of pea size, and is slightly inclined toward the working door. The arch is 1¼ foot above the hearth near the working door while near the end it is only 1 foot above it. The working door, which is as small as possible, is at one end; at both sides there are fireplaces 3½ feet square, the flames entering the furnace by two flues, ¾ by 1 foot large. Some furnaces are built with two working doors; the tubes in such a case are introduced through one door, and are withdrawn through the other. Such a furnace will hold from two to four tubes, according to the width of the hearth; the tubes are so placed that the parts to be welded are acted upon by the flame. The fuel used must have a long flame, be free from sulphur and deposit no soot, because any impurities introduced into the furnace give rise to difficulties. In order to heat the tubes as uniformly as possible for their entire length, three or even four fireplaces have been built along one side of the furnace, the flame, after having passed over the hearth of the furnace at right

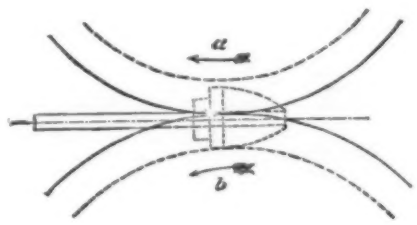


Fig. 4.

angles to its length, entering a large common flue. This arrangement successfully meets the end desired, but at the same time it considerably increases the expense for fuel. At the Lierenfeld Works, near Düsseldorf, the Siemens furnace has been adopted for heating. As near the working door of the furnace as possible is the finishing train which welds the tube. The most important part of this rolling train is composed of two cast-iron disks, *a* and *b*, Fig. 4, 22 to 32 inches in diameter and 6 inches wide, the circumferences of which touch in one point. The drawing gauge formed by their grooves is equal to the exterior diameter of the tubes. The velocity of these disks must be great enough to avoid cooling of the pipe; it varies, according to the diameter of the latter, between 60 and 130 revolutions per minute. In England these disks are set in motion by a system of gearing so arranged that the velocity of the train may be varied. As cleanness is an important point, the disks are provided with scrapers of the form of the grooves. The motor is generally a steam-engine of about 30 horse power, the transmission being effected by means of gearing. The drawing gauge formed by the grooves in the two disks is on the same level as the height of the furnace hearth. As soon as the pipes are heated to a welding temperature, they are seized by double nippers in the hands of two workmen who occupy a position at the sides of the working door, and they are then introduced as rapidly as possible between the two disks. A mandrel of chilled cast iron is placed into the gauge formed by the grooves, its diameter being equal to the inside diameter of the pipe to be welded. The mandrel is pierced by a strong steel bar, against a collar of which it is pressed in rolling. The disks revolve in the direction indicated by the arrows. The end of the bar rests upon a plate which may be adjusted by means of a screw. The pipe is rolled between the mandrel and the grooves of the disks. Generally it is welded in three passes, reheating taking place after every pass. The number of mandrels in stock is very large, as every size of pipe requires a special mandrel, and they are rapidly worn. As soon as the pipe is rolled a workman strikes the end of the bar with a hammer in order to loosen the mandrel, and then the bar may be withdrawn. It is readjusted and a new mandrel is mounted. The work of this man is very laborious, as 300 tubes are made in a day in 900 passes. The rolling requires great care and attention, especially the adjustment of the mandrel.

POLISHING AND SMOOTHING THE PIPE.

The welded pipes are placed into a reheating furnace and heated to cherry redness, and passed through a polishing train. The latter is composed of a gauge plate of hardened cast iron, the interior diameter of which is equal to the exterior diameter of the pipe. The edge of this plate removes the scale and polishes the pipe, which is drawn through it slowly by means of a drawing bench similar to that used in bending the sheets. The pipes are smoothed by hammering them, cold, on a mandrel, with wooden mallets. They are then cut into lengths, and are subjected to hydraulic pressure. Pipe which is to be used for locomotive boiler flues must be reheated for a length of 6 to 7 inches, and enlarged by means of mandrel, which, however, does not affect their solidity.

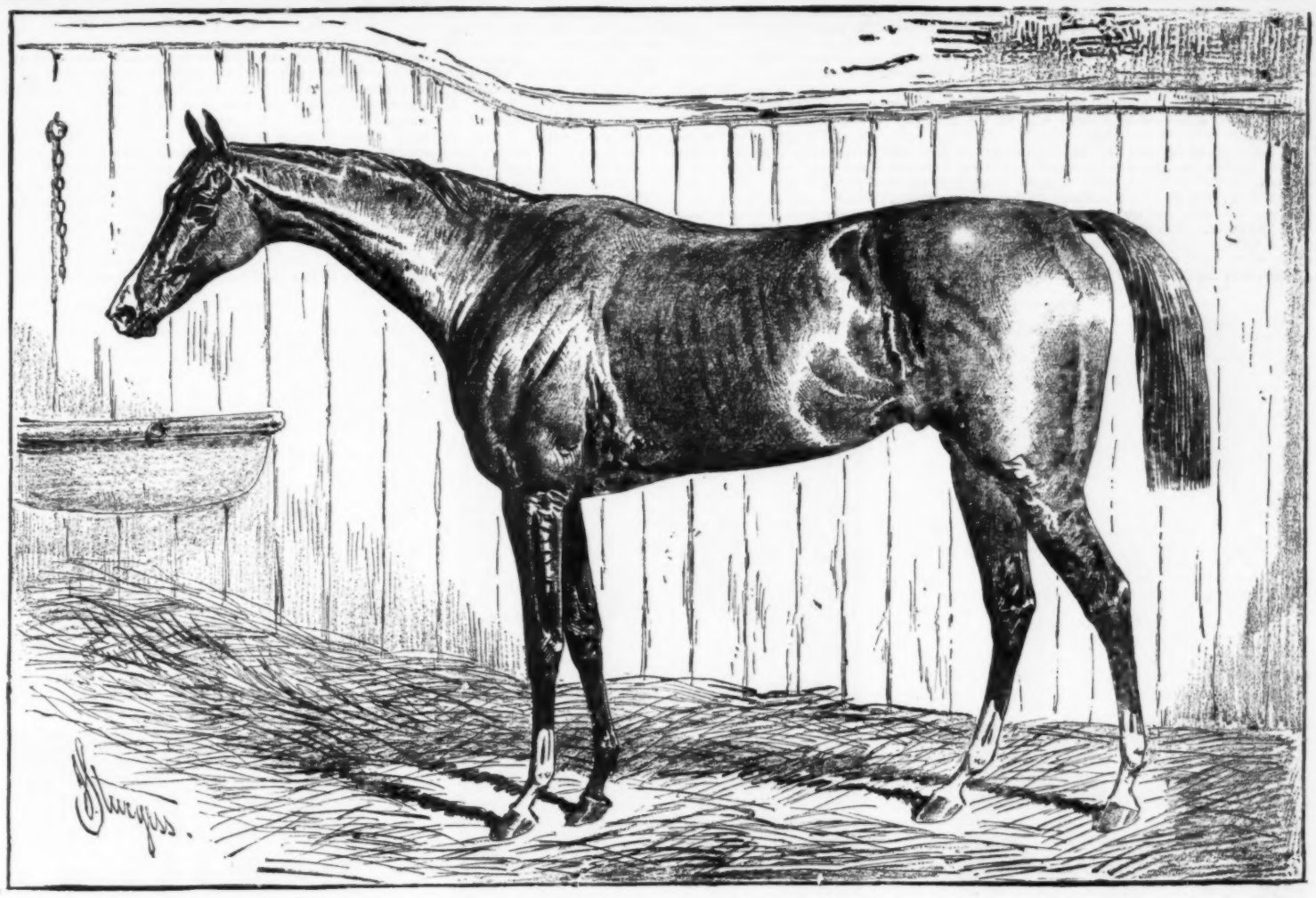
MANUFACTURE OF GAS PIPE.

The manufacture of gas pipe varies from the preceding in the following points:—The sheet used is thicker, because the ends of the pipe must be threaded. As gas pipes need resist a small pressure only, the sheets used may be of inferior quality. They are cut and taken to the reheating furnace. Three methods of drawing pipe may be distinguished: The first is to draw through a gauge plate, a method which has been described above. The second differs from the first because the sheet is first rolled up. This bending is executed at a red heat, either by passing the sheet between a semicircular gauge plate supported by a frame and a mandrel which presses it by means of a series of levers, or by using an elliptical gauge plate at the end of which is a mandrel attached to an iron rod. The sheet thus bent is heated to a welding temperature and drawn on a drawing bench. The peculiarity of this drawing is that the gauge plate is formed by the ends of tongs which differ from ordinary tongs only by the elongation of the arms to both sides, so that they may be worked by two men at both sides of the train. The edges of the gauge-plate are hardened so that the tubes are polished. A workman takes the pipe from the furnace and takes it to the bench. The tube is first drawn for half its length; then it is reheated and goes to the finishing train. In order to make this practicable, it must be possible to open the tongs. The difficulty with two heats is that the iron is easily burned. While they are still hot, the pipes are taken to the apparatus for making their diameter and their thickness uniform. This apparatus consists of a stationary iron table, above which a large heavy iron plate is suspended from its corners; it is moved by eccentric, and causes the pipes to roll about while it presses upon them. The third method combines the peculiarities of both the foregoing—the bending and drawing of the pipe performed at the same time. A pipe already drawn may be, without loss of time, redrawn for a part of its length. The gauge plate is formed of two parts, the lower being attached to a frame, while the upper movable part is moved by a system of levers. Both parts must be adjusted as perfectly as possible; if not, the pipe made will be defective. Cutting the pipe into lengths, threading their ends, etc., are performed in the usual manner.—*Iron Age.*

BUILDINGS AND EARTHQUAKES.

Although in this country earthquakes are happily rare, we know that in southern and eastern lands they are of such frequent occurrence that the architect has to take the stability of his structures into serious consideration. Indian and Eastern architecture generally has been considerably modified by conditions due to this cause, and we know that the Italian mediævalist introduced so largely the tie into his arched openings as to sacrifice, in great measure, the motive and beauty of the pointed style. Japan has especially suffered from visitations of earthquakes, and it is not surprising that the engineers and others engaged in construction should pay special attention to the means best adapted to overcome the shocks to which buildings are exposed. We have before us two pamphlets by Mr. John Perry and Mr. W. E. Ayrton, Professors of Engineering in the Imperial College of Tokio, Japan. In one of these[*] the authors investigate the effects produced by an earthquake on a structure, especially with regard to the time of vibration. Generally it has been assumed that the shock caused by an earthquake produces an impact upon a building, but recent inquirers have shown that it is a wave of elastic compression in any direction, vertically or horizontally, through the earth's crust. These waves of undulation, if we may so call them, are no doubt transmitted to the surface in a modified manner owing to surface irregularities, such as mountain ranges and geological structure. Rocky strata, of course, transmit them rapidly. But we have to regard an earthquake as an elastic compression in some direction. This being so, it follows that a building is affected by an undulation, or rather participates in the vibration of a point of the earth's surface, which vibration may be mathematically determined, or at least approximately so. If we imagine such a wave of vibration to pass under a large building, such as the Law Courts for example, it is obvious some portions of the structure would be affected in a greater degree than others. The lofty square towers would vibrate slowly, compared with the lower parts, and according to the relative height and homogeneity of the masses would be the amount of vibration each part would share. For instance, in a low building we may fairly assume the time of vibration of the shock and of the structure to be approximately equal, if the parts are of the same density; but if the building is lofty it will vibrate more slowly. A slowly vibrating structure is necessarily subjected to stresses of a complicated kind, and more severe than those of a quickly vibrating one. It is not difficult to comprehend the truth of this proposition, and Messrs. John Perry and W. E. Ayrton have shown that the stability of structures subjected to earthquakes depends mainly upon the quickness of their vibration, or, in other words, on their rigidity of structure and lowness. A slowly vibrating structure—that is to say, a lofty building—will probably, as our authors say, "get broken in its connections with the foundations, if these be rigidly fixed to the ground; consequently (and we must here oppose the practice of many architects and engineers), putting a heavy top to a lighthouse, the chimney of a factory or other high building, must certainly take from its stability." As they observe, "it is the relative velocity of the base of the structure, with regard to the other parts, which is the fixed quantity, and therefore that the more massive the structure, the more momentum enters it through the base." An ordinary Japanese two-storied house, with its heavy roof, it is supposed, takes four seconds to make a complete vibration, the restoring forces which bring the structure back to its normal position being due to stiffness of the joints, and to the fact that the house is not rigidly connected with the ground. It will surprise the English architect to learn that the Japanese houses are without the foundations we are accustomed to use; the vertical posts rest on detached stones, and there are no diagonal braces. Thus the building can be

[*] On Structures in an Earthquake Country. By John Perry and W. E. Ayrton, Professors in the Imperial College of Engineering, Tokio, Japan.



VERNEUIL, WINNER OF THE ASCOT GOLD CUP.

displaced from its position of equilibrium by any shock without fracture occurring. There is a "viscous resistance," as the authors term it, to the motion, caused by the various joints, and such resistance diminishes the motion and adds to the safety of the building. Particular stress is laid on this viscous resistance of the joints, and also to the absence of diagonal pieces to lessen the strains. The Japanese temples are considered pretty secure against shock, as they are buildings of slow vibration, and have a great deal of viscosity in their joints. It must be borne in mind that a rigidly connected foundation is independent of the mass of building, and the shock tends to displace at any weak point or surface of contact between different portions. All non-homogeneous buildings have some parts only capable of slow vibration compared to others. The authors justly say that there is a best method of constructing buildings in an earthquake country: this obviously consists in constructing the lower parts of the building with yielding material, so that the shock from an earthquake may be reduced in intensity and the vibration of the upper part diminished. A rocky or rigid foundation, on the other hand, transmits the vibration or momentum undiminished to the upper parts. Again, a foundation of yielding timber or some soft elastic substance would form a cushion by means of which the time of transmission of the momentum due to the shock may be increased. The authors point out it is desirable to keep houses built of ordinary wall thicknesses, with brick and common mortar, as low as possible—at most not more than two stories high; but if good cement be employed instead of bad mortar, then their height may be safely two or three stories. Another point is the horizontal vibration of the ground. This causes a kind of shearing stress in the joints which mortar cannot transmit, and it is desirable, therefore, to make the joints rigid in cement so that the walls may resist a sliding as well as a crushing stress. No doubt we have here a strong argument in favor of cement concretes for building walls in earthquake countries. At any rate it is laid down that the most suitable structures for these contingencies, if of stone, are those built of large stones set in good cement, with walls of considerable thickness at the base, diminished gradually in proportion to the mass and height of the building, and we have a strong presumptive argument in favor of pyramidal buildings. As timber has greater tensile resistance to shock, and as the mass of timber in a building is small, a building of this material is even more desirable if constructed with strong joints, while wrought iron and steel have still stronger claims in these respects. Another hint is given—namely, that timber structures should not be too rigidly fastened to the earth. Without going into the calculations of the times of vibration of different buildings given by the authors, as regards shape and height, it is obvious the conclusions drawn by them are convincing; and that, to insure stability in structures liable to shocks, the relative vibrations of the parts of the structure of any given material must be taken into account. Thus, high chimneys, such as many engineers have erected recently, crowned with heavy cornices, are unsafe in a country like Japan; for, as the authors show, the period of natural vibration of a chimney 150 feet high and 10 feet square is about 2¼ seconds—a period much too slow to be safe when connected with the walls of a building of less height and consequently of less vibration.

We here turn to another very interesting paper read by the authors before the Asiatic Society of Japan,* in which the motion caused by an earthquake is investigated. The principle our authors set out with is that it is possible to read an earthquake message by the motion of a body attached to the earth by springs. Thus "the center mass of a body fastened by means of springs inside a metal box rigidly attached to the earth has in certain cases motions with respect to the box itself which in miniature with great exactitude represent the motions of a point of the box during the earthquake." Here we have a self-evident principle upon which an apparatus for recording vibration can be constructed. Without diagrams it is difficult to convey a correct idea of the seismometer of Messrs. Perry and Ayrton. But we may describe it briefly as a strong iron case rigidly fixed to the rocky crust of the earth, with a leaden ball of 400 lbs., supported by five strong spiral springs, four of which are horizontal and one vertical, all having the same period, so that if there were no friction the ball would describe an ellipse when freely vibrating. To record the different horizontal movements there are three arms with pencils; these are made to press by means of spiral springs on a band of paper moved horizontally by clockwork. By these and other means an automatic register of the motion of the earth is diagrammatically made, and these diagrams assume irregular spirals on the paper. Thus the position, velocity, direction, and acceleration of the ball at any moment are recorded, and, therefore, the motion of any point upon the earth's surface is also registered. Professor Palmieri and others have invented electro-magnetic seismographs, to record earthquake vibrations and intensities, but the exactitude of the records made has been questioned by Mr. Mallet and other authorities in the science of seismometry. We may simply add that the authors propose to place three of their instruments on the plain of Yeddo, with clocks in telegraphic communication, by which means the vibration and motion of an earthquake-wave could be determined. We only hope the ingenious authors will be assisted in their experiments by the Japanese Government, and that facilities to perfect their instruments will be afforded them in the interests of science and humanity.—*Building News.*

* On a Neglected Principle that may be Employed in Earthquake Measurements.

VERNEUIL.

To follow up a victory in the Derby with one in the Ascot Cup is the honorable ambition of every owner of the presumedly best horse of his year; but though, since 1868, Blue Gown, Cremorne, and Doncaster have all set the orthodox seal on their fame in this manner, Silvio is only one of a tolerably long list of Epsom heroes who have had the misfortune to meet a Verneuil "up the dreadful steep" of Ascot. Verneuil is a chestnut colt, standing, as near as we can guess, 15 hands 3 inches. He possesses immense muscle and power, is splendidly put together, and stands on short legs which look like carrying him safely through a long racing career. He was bred in France by M. Lefèvre, and is by Mortemer from Regalia; so, with such blood in his veins, it is no wonder that he can race, for his sire was, perhaps, the best "all-round" horse that ever trod the turf, cutting down a field of T.Y.C. fliers in a Stockbridge Cup on one day, and staying far too well for the best cup horses of his time, over two miles and a half, on another. Nor was Regalia much less distinguished in her way, teste her six-lengths' victory in the Oaks of 1865, and that she was the only three-year-old of that season who could make even the semblance of a struggle against the mighty Gladiateur, to whom she finished second in the Leger. Verneuil made his début at Goodwood, in the Prince of Wales' Stakes, in 1876, in which he was unplaced; but four more attempts that season produced a couple of successes, the most important of them being obtained in the Buckenham Stakes at New market, in which he upset the odds of 7 to 4 laid upon Silvio. Last year he came out no less than fourteen times, and, though he developed a most disappointing habit of running second, his number went up on five occasions, his most important victory being gained in the Jockey Club Cup at Newmarket in the autumn. He has run four times unsuccessfully prior to the Ascot Meeting this season, and no one could have been at all prepared for his brilliant achievements on the Royal heath. As his two great races are described in "National Sports," we need not allude to them here, and will only say that the Gold Vase, the Ascot Cup, and the Alexandra Plate have never before been swept off by one animal; that he galloped no less than seven and a half miles in his three races, and that, as he made the whole of the running, and was never headed from start to finish in any one of them, he must be an extraordinary stayer. We must not omit to mention that Verneuil is the property of Count Lagrange, and was admirably ridden by James Goater, the first jockey to the great French stable.—*Illustrated London News.*

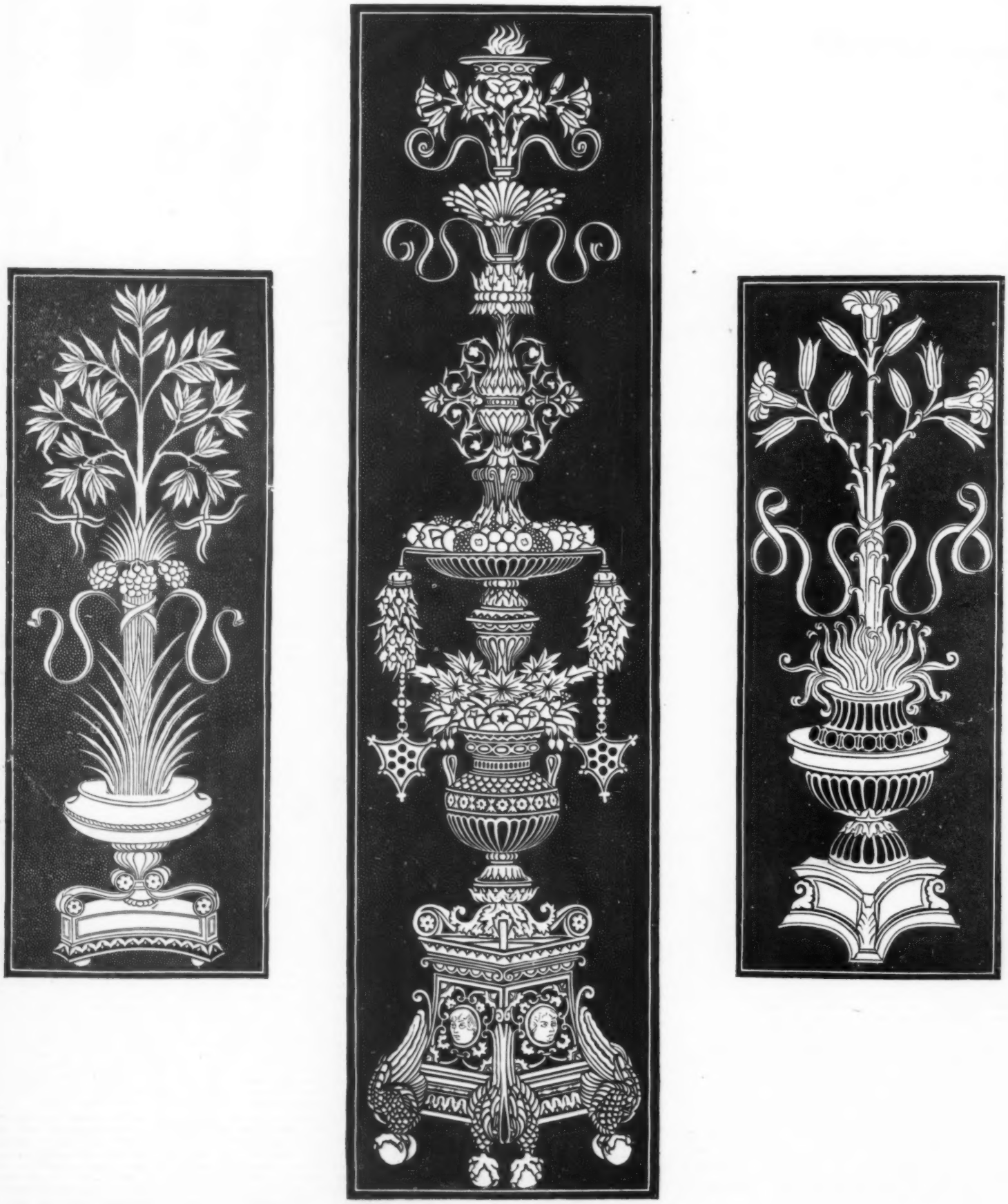
A CHINESE TORNADO.

CORRESPONDENCE of the Hong Kong *Daily Press*, dated Canton, April 14, gives the following particulars of the terrible tornado which visited Canton and its suburbs on the 11th of April: Passing over the Shameen settlement the storm crossed the canal to the city, carrying away in its course the balustrading of the East bridge. A native police station opposite was also completely destroyed. The storm leveled all the houses in its course, making a clean sweep of everything for a width of about six hundred feet. The mortality has been variously estimated at from five to ten thousand, and probably the latter number is nearer the mark. Nine thousand houses (speaking in round numbers) are known to have been destroyed, and although many of the inmates had notice of the impending disaster by hearing the noise caused by other houses falling, and made their escape, there were other cases in which great numbers of people were killed by the fall of a single house. For instance, there was an eating-house in which fifty-two assistants were engaged. In this house there were at the time over one hundred people taking refreshments, and none, either assistants or guests, are known to have escaped. In another case twenty-four persons were killed by the destruction of a family house. There was also great destruction of boats and life on water. Allowing, therefore, for there being no one in many of the houses at the time of their fall, and, on the other hand, allowing for there being great numbers in some of those that fell, it is probably below the average to estimate the loss of life at one to each house that fell, and a thousand lives on the water. In most of the houses blown down fire was probably being used, either for cooking or other purposes, and kerosene is now so universally burned that it would have been no cause for surprise had the conflagrations been much more extensive than they were. As to the clearing away of the dead bodies, the Chinese authorities seemed to have acted with commendable promptitude. Almost immediately after the catastrophe orders for four thousand coffins were issued by the Ol Yuk Tong hospital, and up to the time the steamer left yesterday afternoon three thousand bodies had been recovered from the ruins and buried without delay. The work of clearing away the débris was proceeding rapidly, but the stench in some places was unmistakable evidence that there were dead bodies still to be extricated. The violence of the wind for the few minutes

it lasted was as great as that of the severest typhoon. Granite blocks were lifted from their places and hurled a considerable distance; thick trees snapped in twain like twigs; roofs were lifted bodily, and boats carried far on to the shore. In one case a small boat was actually blown on to the roof of a house in the Tenth ward. A row of houses—all brothels but one, forming one side of a short line in the city—were the scene of one notable catastrophe. The other side of the lane is formed by the side wall of the Nam Cheong temple, which is some thirty feet high. This wall gave way to the force of the tornado and fell crushing in upon the opposite houses, the inmates of which, about one hundred in number, were all killed, most of them being crushed to death, and the remainder suffocated. There was no means of exit at the back, and no one attempted to dig the bodies out of the ruins. The narrow creek is still partially choked up with débris, consisting of broken boats and other wreckage, in which are numbers of dead bodies. In too many instances whole families have been crushed to death in one boat. The supply of coffins is nearly exhausted, and the undertakers are now, I am told, charging double price. The villages of Pah Hin Hock and Pah Hock Tang, two or three miles to the north, outside the walls, were caught in the storm and suffered great damage, many dwelling houses and other buildings being destroyed and numbers of lives lost. The village across the water opposite the Shameen came in for its share of the disaster also, being partially destroyed. I hear that, though the whirlwind did not effect so much damage at Fatshan as in this port, it has made severe havoc. It is stated by Chinese who have come from there that no less than two hundred houses have been laid prostrate, while about half the boats in the river there have been wrecked. The loss of life has been put down at several hundred. A passage boat coming from Fatshan to this city was, when a short distance off, caught in the tornado and instantly capsized. About seventy of the passengers were drowned. The tornado, it appears, came from a direction quite contrary to that in which the cloud had traveled immediately preceding it.

UTILIZATION OF THE WASTE WATERS OF FULLING MILLS AND WOOLEN WORKS.

E. Neumann dissolves crude chloride of calcium in an equal weight of water, and adds from one to two measures per cent. of this liquid to the waste waters, according to the amount of fatty matter supposed to be present. The whole water, along with the calcareous soap thus formed, is pumped into a filter-press, in which soap, dirt, hairs, etc., remain, while the water flows off. The press-cakes obtained are either air-dried and used for the manufacture of oil-gas or for the preparation of fat. For the latter purpose, Neumann stirs up the press-cakes to a thin paste with muriatic acid, and presses the mass through a filter-press heated by steam. The fat and the regenerated chloride of calcium flow into small tubs, from which, after a time, the solution of chloride of calcium, along with the excess of muriatic acid, are let off into a tank containing chalk, which forms, with the muriatic acid, a further portion of chloride of calcium.



SUGGESTIONS IN DECORATIVE ART—MARQUETRY ORNAMENTS FROM FLORENCE.—*From the Workshop.*

which serves for the precipitation of a fresh lot of waste water. The fat is heated to 180° Fahr., with 10 per cent. of sulphuric acid at 10° (Baumé?), whereupon it rises to the top and becomes clear when it is drawn off. The process has been patented in Germany, but it is doubtful upon what the patent can be based, since Vohl previously proposed chloride of calcium for the very same purpose. In spite of its apparent advantages, this process has not met with general acceptance, probably because compounds of chlorine are so difficult to remove from the fatty acids. The same fact is the reason why in the manufacture of stearine sulphuric acid has to be used in the place of muriatic for the decomposition of the calcareous soap.—*Deutsche Ind. Zeitung und Chemiker Zeitung.*

ON THE JOINT ACTION OF RED PRUSSIATE AND OF CERTAIN ACETATES UPON INDIGO.

By ALBERT SCHEURER.

INDIGO exposed to the oxidizing action of a mixture of caustic soda and of red prussiate is instantly destroyed. Upon this fact is founded a process which has been employed for a long time with success for the production of discharge styles upon vat blues. The dyed goods receive a design in a color made of red prussiate, suitably thickened, and the operation is finished by a passage through caustic soda.

The same reaction is produced on steaming a swatch of vat blue printed with red prussiate, to which any acetate has been added. In this case the destruction of the coloring matter varies in direct proportion to the power of the base of the acetate employed, and inversely as the energy with which this same base retains acetic acid at the temperature of 212°

The colors used by the author contain in an equal bulk the same quantity of red prussiate with one equivalent of acetate.

The following is the list of the bases, the acetates of which have been employed; they are arranged in order, beginning with those which answer best:—Lime, magnesia, oxide of zinc, oxide of lead, oxide of manganese, baryta, soda, potash, strontia, ammonia.

Among these bases, two—the oxide of zinc and that of manganese—are found precipitated in the color in the state of ferricyanides. It is curious to find that this fact is not an obstacle to the destruction of the indigo.

Ferricyanide of zinc, washed and thickened with gum tragacanth, confirms this result, while the red prussiate of potash alone, placed in the same conditions, attacks indigo only very slightly.

Ferricyanide of magnesia, free from all alkaline influence, in a color mixed with sulphate of magnesia and red prussiate of potash, discharges medium vat blues perfectly.

Hence we learn that certain ferricyanides do not require the presence of an alkali to be capable of reduction. We observe also that red prussiate of potash, printed upon a medium blue ground along with the sulphate of ammonia, destroys the indigo, and forms Prussian blue. A passage through weak soda lye removes this blue, and produces a white.

Action of Chromates upon Indigo in an Atmosphere of Steam at 212° Fahr.—Consi lerable use has been made of the action of chromates, followed by a passage through sours, to produce discharge effects upon vat blues.

The use of steam produces the same reaction, less energetically, indeed, but still sufficient to destroy a medium vat blue.

Bichromate of potash in presence of a metallic sulphate or chloride, and under the influence of steam at 212° Fahr., destroys indigo, producing at the same time oxide of chrome, chromate of chrome, and chromate of the metal employed. The presence of this latter body renders it possible, in cases where the action has not been violent enough to make the blue disappear, to terminate this action by a passage through sulphuric acid or sulphate of magnesia.

The following is the list of the colors tried:

1. Bichromate of potash. Potash alum.
2. Bichromate of potash. Ammonia alum.
3. Bichromate of potash. Chrome alum.
4. Bichromate of potash. Sulphate of ammonia.
5. Bichromate of potash. Sulphate of magnesia.
6. Bichromate of potash. Copperas.
7. Bichromate of potash. Chloride of manganese.
8. Bichromate of potash. Sulphate of zinc.

None of these colors gives a white, on account of the fixation of the oxide of chrome and of the chromates upon the fiber.

No. 3 gives the bronze shade of the chromate of chrome.

The dirty tone of 1, 2, and 4 shows a mixture of oxide of chrome, with a large proportion of chromate of chrome.

No. 6 gives a very full buff shade, not deficient in brightness; chromate of iron.

No. 7 gives a bronze of chromate of manganese.—*Bulletin de la Soc. Indust. de Mulhouse.*

MANGANESE AND CHROME BLUES.

M. GASTON BONG, in the *Bul. de la Société chim. de Paris*, says this blue is obtained on igniting silica and any compound of manganese with baryta, or a mixture of soda and lime in an oxidizing atmosphere. Either of the following mixtures may be used:

Silica	3	or Silica or kaolin	3 or 2
Soda-ash	6	" Barium nitrate	8
Carb. of lime (free from iron)	5	" Oxide of manganese (free from iron)	3

The proportion of manganese affects the intensity of the blue, but not its tone. By increasing the proportion of alkali or silica, a green or a violet tone is produced. The use of potassa does not give good results. The ignition should be effected at a red heat, in the absence of reducing gases. These facts lead to a very delicate process for detecting the presence of manganese, especially in earthy substances. If to one of the above mixtures, made of materials free from manganese, any substance containing a trace of that element is added, a blue color appears on ignition. The same author obtains a chrome blue with the following materials, which are intimately mixed and strongly calcined with free access of air:

Boric acid	15 parts.
Alumina	15 "
Carbonate of magnesia	20 "
Chromate of baryta	3 "

ALIZARINE BLUE.

PROFESSOR GRAEBE has read a paper before the Chemical Society of Zürich on a new blue coloring matter derived from alizarine, and introduced into the market by the "Baden Aniline und Soda Fabrik," of Ludwigshafen, under the name of "alizarine blue." M. Prud'homme first pointed out the formation of a blue coloring-matter by the joint action of glycerine and sulphuric acid upon nitroalizarine. Brunck succeeded in preparing it upon an industrial scale. It is sold in the form of a fluid paste of a brownish-violet color, and is used almost in the same manner as alizarine. As it is sparingly soluble, and forms with lime lakes almost insoluble, its application requires more care than that of alizarine. It dyes more readily if a little soap is added to the beck. With iron mordants the color does not print well, but with yellow prussiate pure shades are obtained.

The new dye gives greenish-blue lakes with lime, baryta, and iron; reddish-blue with alumina, violet-blue with chrome, and violet-red with tin. Goods mordanted with the salts in question are dyed corresponding shades, that obtained with iron much resembling indigo. All are distinguished for their solidity, being affected neither by soap nor by chloride of lime. Like indigo, the new color is reducible in an alkaline solution. With zinc-dust, hydrosulphurous acid or glucose, along with an alkali, there are produced yellowish-brown solutions, from which the blue color gradually separates again on exposure to the air. Unmordanted tissues worked in such a vat are dyed blue.

By means of crystallization from benzole, the coloring matter is obtained in violet-brown needles of a metallic luster. It melts at 518° Fahr., and if heated more strongly emits orange-vapors, which condense in bluish-black needles. It is almost insoluble in water; slightly soluble in benzole and alcohol, with a red color; more soluble in glacial acetic acid, which at a boiling heat transforms it. With dilute alkalies it forms bluish green solutions, from which an excess of alkali throws down the salts of blue alizarine blue. It is a nitrogenous body.—*Berichte der Deutschen Chemischen Gesellschaft.*

A NEW ANTHRACENE BLUE.

As early as 1872, Dr. Springmühl pointed out the existence of a fine blue coloring matter derived from anthracene, but he was not able to prepare a sufficient quantity for a thorough examination, and has only been able to resume the investigation in 1877.

The starting point for the preparation of the color in question is anthracene, as pure as possible, treated first with alcohol, benzole, and sulphuret of carbon, melting at 410° Fahr., and after sublimation at 415°. On oxidation of chromic acid, dissolved in glacial acetic acid, it furnishes pure anthraquinone, which does not yield the blue color, but if treated with bichromate of potash in powder in the same solvent it yields along with the anthraquinone another substance capable of producing the blue. The bichromate of potash is added to the solution by degrees, and when the first violent reaction is over it is heated until the mass appears of a deep green. The water formed is then evaporated off in the sand-bath, without allowing the heat to rise too high. The residue is treated with boiling water until nothing more is dissolved, and is then sublimed. A sublimate of needles is obtained, partly yellow and partly red; the former are anthraquinone, but the latter a new substance essentially distinct. If treated with hydriodic acid and phosphorus, or heated with zinc-dust, it does not reproduce anthracene, which causes us to believe that it is not derived from that hydrocarbon, but possibly from another substance resembling and accompanying it. If melted with potash it does not yield benzoic acid, and dissolves neither in the alkalies nor in ammonia. The red crystals, carefully picked out and exhausted with boiling benzole so as to eliminate the last traces of anthraquinone, yield on analysis figures agreeing with the formula $C_{14}H_7O_2$. This compound was heated for three hours with fuming nitric acid in a flask fitted with a reflux refrigerator. The acid was then distilled away, and the residue washed with water till the washings were no longer acid. The result was a white powder, insoluble in water and alcohol, but soluble in potash. The potassic solution was heated for 12 hours in a closed vessel, the contents of which remained colorless and limpid. On opening the vessel and exposing the solution to the air it took an intense blue coloration.

If the excess of potash is neutralized with an acid, it dyes silk and wool a splendid blue, without either green or red reflections. Cotton is only dyed after being mordanted with a salt of tin.

Acids throw down anthracene blue from its alkaline solutions as a dark-colored powder, which, on drying, takes a metallic luster, but which hitherto has not been obtained in the crystalline state.

This product has evidently, at present, no chance of becoming industrially available, but the author is continuing his researches in the hope of preparing anthracene blue by a less complicated method.—*Muster-Zeitung.*

USEFUL RECIPES.

BY JAS. W. PARKINSON.

Kisses.—Beat with a wire whisk the whites of eight eggs to a stiff, solid froth, then stir gently in by degrees one pound of the finest powdered sugar. If you desire to have them flavored add a few drops of lemon oil, or a teaspoonful of any extract you may fancy. Lay the mass out, in shape of small half eggs, with a dessert spoon, on sheets of white paper, which must be laid on boards at least one inch thick—this is done in order that the kisses may receive no bottom heat. After they are so laid out, sieve fine sugar over the top, and then bake them in a moderate oven; a few minutes after they are taken from the oven remove them from the papers with a thin pallet knife, and join two of them together, thus forming the shape of a small egg. This mass may be laid out on papers as above described, by the aid of a canvas bag, fitted with a tin nozzle, into rings, shells, fingers, rosettes, etc., and with chopped almonds, filberts, or pistachio-nuts strewn over the tops, and then baked of a very light color.

Cream Cake.—Put one and a half pints of water and a quarter pound of butter in a round-bottomed pan, place it upon the fire, and when it boils stir quickly in one pound of sifted flour, and stir it vigorously with a wooden spatula; now remove it from the fire, and beat in, one at a time, sufficient eggs to form a rather soft, smooth, sleek paste—eight or ten will be enough. With a spoon, lay out this mass in the form of round cakes or lumps, on greased baking tins, some distance apart, as they expand considerably. Bake in a hot oven.

When cold, split them open at the side, and fill with a lemon or vanilla custard cream.

The Custard: Beat six eggs with half a pound of pulverized sugar; add one pint of milk; flavor with vanilla extract; place it upon the fire, and stir constantly until it thickens; then remove, and when cold fill your puffs.

Apples à la Turque.—Pare and core a dozen good apples, put them into a basin with some thin sirup and the yellow rind of a lemon; cover them closely and simmer them gently until they are soft and clear. Take them out and lay them on a dish with wet white paper over them; this will prevent them from discoloring. Now cover a dish with puff paste; prick the bottom and bake it. When the paste is done, fill the holes made by the removal of the cores in the apples with raspberry jam, and arrange them on the paste in the shape of a cone. Beat the white of six eggs to a stiff snow, and add to them six ounces of fine white sugar. Mix this gently in, then pile this meringue mass upon the apples. Sift some fine white sugar over it and set it in the mouth of the oven until baked a light brown color.

Mead or Metheglin.—1. Take to each gallon of water three pounds of strained honey, boil these gently together for about one hour, add to it, while boiling, one-half ounce of good sound hops, skim carefully, and drain the skimmings through a hair sieve, returning what runs through; remove from the fire, and when the liquid is lukewarm stir into it a half pint of good staunch yeast; this quantity will serve for nine gallons of mead. Now, put it into your cask and let it work over, filling it up till fermentation subsides. Paste strong paper over the bung-hole. This mead may be flavored with spices while boiling.

Mead is a very wholesome and pleasant beverage, very grateful in summer, and but little inferior to some of the white wines, and will keep a very long time.

2. Take ten gallons of water, two gallons of honey, a handful of dried ginger root, and two lemons cut in slices, mix all together, and boil for half an hour, carefully skimming it all the time, and during the boiling add two ounces of hops; remove from the fire, and when the liquid is lukewarm add a strong yeast, and then cask, and allow it to work. In about three weeks after working off it will be ready for use.

Bread without Yeast, or other ferment, is beyond my ken, unless it be in the form of biscuits or crackers.

These are compounded of flour, water or milk, and butter or lard. The unleavened bread of the Israelites is made of a dough composed simply of flour and water, rolled out thin and baked.

Biscuit.—A very good biscuit may be made as follows, without the use of ferment; they are called *Maryland Biscuit*, and if well made are nice for breakfast or tea. Take any desired quantity of flour, put in salt, and a lump of lard; rub it well into the flour, and moisten it with sweet new milk; work it well, and beat it with a rolling-pin until perfectly light. Bake in a moderate oven to a light brown color.

Doughnuts.—Make one pint of milk warm, melt in it a quarter of a pound of butter, four well-beaten eggs, and one pound of sugar. Stir the sugar into the eggs, grate in half a nutmeg, add half a gill of yeast, mix all together, and thicken it into a soft dough with sifted flour; now roll the dough, and form or cut out your doughnuts, place them on a floured board, and put them in a warm situation to rise. When they are light, fry them in boiling lard to a light brown color, drain them in a colander, and sift fine white sugar over them.

Crumpets.—Make two pounds of sifted flour into a dough, with warm milk and water, adding a little salt, three eggs well beaten, and three tablespoonfuls of yeast; mix all well together, and reduce it with warm milk to the consistence of this batter. Set it in a warm situation to rise, and when sufficiently light pour it into buttered pans or tins, and bake slowly to a light brown color.

Glair of Eggs is a brilliant glaze for pastry or cake; its preparation is simple. Whisk the whites of eggs to a froth, and let them stand for twenty-four hours, and then strain them through a muslin cloth.

Ratafia de Framboises.—Bruised raspberries, eight pounds; proof spirit, two quarts; white sugar, one pound; mix and infuse in a corked demijohn for a week, occasionally shaking it, after which filter and bottle.

Ratafia de Cerises.—Select for this liquor a dark, rich, juicy cherry, of which take eight pounds, mash and bruise the kernels, cover all with one gallon proof spirit, and add two pounds white sugar dissolved in one quart of water. Put all into a close vessel, and digest for ten days, after which filter and bottle.

To Color Sugar Sand.—Take a pound of white pulverized sugar, sift this in a lawn sieve in order to take out the finer portions. Put the coarser grains into a preserving pan, and gently warm it over the fire, stirring continually with the hand; pour in a sufficient vegetable liquid color to give the desired tint, and continue to work it about the pan until dry.

Raspberry and Currant Paste.—Take any desired quantity of red currants and raspberries in equal proportions, mash them together in a preserving pan, and boil them for ten minutes, stirring them with a wooden spatula; remove them from the fire, and when cool enough rub and press them through a hair sieve into a clean pan, and for every pound of pulp add one pound of pulverized white sugar; set this over a brisk fire, stirring constantly until the paste is sufficiently evaporated to show the bottom of the pan as you draw your spatula across it; then remove it from the fire, and while it is yet warm lay out the paste in drops about the size of half dollars on sheets of white paper, laid upon coffers or sheets of tin. They should then be placed in the drying closet, and allowed to remain for several days or until they are dry. They may now be laid away in closed boxes, kept in a dry place, until wanted for use. This is a delicious paste, and when removed from the papers, and two of them interlarded with a fondant cream, and crystallized, makes a most beautiful and desirable winter bonbon.

Cheese-cake.—Four eggs well beaten, stirred into one pint of boiling milk; then put your pan containing the milk and eggs on some coals or a stove; stir them until it curdles; then strain off the whey, and let the curd cool; grate six ounces of stale sponge cake and mix with the cold curd; stir half a pound of butter and the same weight of pulverized sugar to a cream, add a wine glass of brandy and Madeira mixed, a little rose-water and powdered cinnamon; mix all these ingredients together. Have ready a nice puff paste, roll it out very thin, and cut it into squares about four or five inches wide; place a large spoonful of the cheese mixture in the center of each square, spread it a little and fold

the edges of the paste partly over it, press and pinch down the corners. This forms a flat square tart. Sprinkle a few Zante currants in the center on the uncovered portion of the cheese; place them on baking tins and bake in a moderate oven.

Cocoanut Macaroons.—Pound three-quarters of a pound of blanched sweet almonds to a fine smooth paste, in a stone mortar, with the whites of two or three eggs; then add and pound in one and a half pounds of pulverized sugar, and the whites of three more eggs; now add half a pound of grated cocoanut, mix all well together, and lay out the paste in the form of small ovals, on sheets of white paper, laid on tins or boards. Bake in a slack oven to a light yellow color.

Orange Slices.—Remove from the oranges all peel and white pith, and separate the fruit according to its natural divisions, taking great care not to break or tear the thin skin covering the pulp of the fruit; place the slices on hair sieves, and set them in a warm situation for several hours to dry. The best plan is to prepare your fruit the day before you want to use it, and let it dry in the ordinary warmth of the room. Boil one or two pounds of crushed sugar to the crack, dip the pieces of orange into it. The best and quickest plan to do this is to dip one-half of the slice and lay it upon the oiled tin or slab, and when all are done begin again with the first piece and dip the other half, and so continue until all are done; in this way they are dipped effectually and expeditiously, without any danger of burning your fingers. When all are done, they may be formed into any fancy shape, in pyramid form, or they may be arranged on glass dishes, and decorated with green leaves and orange blossoms.

Ice Cream.—Take the very best cream, and for each quart used add one-half pound of white sugar and two eggs; mix and stir these well together, and for each four quarts add one bean of vanilla split and cut into small pieces. Place this mixture upon the fire, and bring it to the boiling point, then remove it at once, and strain it through a hair sieve; continue to stir it occasionally until it is nearly cold; then pour it into a freezer and finish in the usual way.

Fruit Ices.—These are a composition of sugar water and any fruit juices. To the juice of twelve oranges and two lemons add three-quarters of a pound of pulverized sugar. Infuse for an hour the *yellow rind or zest* of three of the oranges (religiously avoiding the white underlying skin or pith, which is extremely bitter and would deprave the flavor) in one pint of water; strain and add this to the juice and sugar; stir well together and freeze in the usual way.

Lady Fingers, or Naples Biscuit.—Separate the whites and yolks of twelve eggs, and whisk the whites of the eggs to a stiff snow; add one pound of sifted sugar to the yolks, and beat well until the batter becomes light and creamy; now add gradually one pound of sifted flour and a little rose water and beat well in; pour this batter into the whipped whites and mix all lightly; fill a bag or biscuit forcer with the batter and lay out your fingers on sheets of white paper, placed on tins or boards; when the sheets are full sift some fine sugar over the tops, blow off any excess of sugar, and bake them in a moderate oven. When done, remove the fingers from the paper by passing a wet brush all over the under side of the biscuit paper, and in a minute or two after the fingers may be easily taken off without breaking; stick two of these together.

White Bride Cake.—Take one pound of butter, put it into a basin and beat it with your hand until it comes to a fine cream; then add one and a quarter pound of pulverized sugar, and beat together till it is fine and white; then add one pound of sifted flour, give it a stir and add the whites of fourteen eggs; continue to beat it, and add another pound of flour and fourteen more whites; beat well and add a gill of the best brandy; mix all well together, paper your hoop round the side and bottom, put in your batter and bake in a moderate oven.

Scalloped Clams.—Scald the clams and chop them up fine; butter a pan and put in a layer of grated bread-crumbs, a few small pieces of butter, a little chopped parsley and a dust of pepper, then a layer of chopped clams, and so alternate until you have the desired quantity, the last layer being crumbs, upon which lay several pats of butter; now pour on top a portion of the strained juice in which the clams were scalded. Bake in a moderate oven for three-quarters of an hour.

Iced Soufflé.—Mix thoroughly together one pint of syrup at thirty-two degrees of strength with the yolks of fifteen eggs; strain it through a sieve into a copper basin that has been slightly warmed, and add half a pint of strawberry or other fruit juice, half a pint of maraschino, and a pinch of salt; whip this mixture vigorously (with the bottom of the basin standing six inches deep in hot water) till it becomes a staunch creamy batter and feels tepid to the touch; remove the basin from the water and continue whisking the composition for ten minutes longer; then lightly mix in one pint of whipped cream. Have a large freezing can set in ice; place in this a paper case, which must have a wide band of very stiff paper, one inch higher than the case, pinned closely round it; pour the composition into the case; and when the band is removed the soufflé will have the appearance of having risen out of the case, like an ordinary soufflé; cover the surface with some powdered brown Naples biscuit and send to table.

Sugar for Crystal Work.—Sugar for crystallizing purposes requires the degrees of the blow and feather, say from thirty four to thirty-eight degrees by the saccharometer. The particles of sugar being brought together within the sphere of their activity, the attraction of cohesion commences, whereby they attach themselves together and form quadrilateral pyramids, with oblong and rectangular bases. The nature and principle of this operation are these: First, *when the water has absorbed as much sugar as it is capable of containing in a cold state*, by continuing the boiling a further portion of the solvent (water) is evaporated, and sugar remains in excess, which, when exposed to a less degree of heat, separates itself and forms crystals on the surface and sides of the vessel in which it is contained, and also on anything placed or suspended in it. But if it is exposed too suddenly to the cold, or disturbed in its action by being shaken, or if the boiling has continued too long, the crystals will form irregularly by the particles being brought in too close contact and run too hastily together, forming a mass or solid lump. To be sure of perfection in sirup for crystallizing purposes, the boiling should be rapid, and continued no longer than till a few drops let fall on a cold surface show a crystalline appearance, or after being removed from the fire a thin skin will form on the surface. A few drops of spirits of wine or of acetic acid added just before the sirup has attained the proper degree, will conduce to a more perfect crystalline form, as they have a great affinity to water, thereby causing the sugar to separate itself more freely; but it must be used with caution, as too much will cause the sugar to granulate. For cocoanut cake the sugar must be boiled to the *ball*.

To Restore the Fragrance of Oil of Lemon.—There are several oils that by absorption of oxygen from the air will become camphorated, grow turbid, deposit a residue generally called stearopton, and lose more or less of their flavor, instead of which they acquire the odor of turpentine. Those oils that are free from oxygen are chiefly subject to these changes, and it is therefore necessary to keep them in full bottles, well stoppered and in a cool place. When they have deteriorated in the way indicated they may be improved, but can never be restored to their original quality. Many means have been proposed for this purpose, but the one now generally employed is to shake the oil with warm water several times, letting it settle and drawing it off by means of a siphon. It may lastly be filtered through paper or linen.

To Keep Oil of Lemon Fragrant.—To every pound of oil one ounce of alcohol is to be added, and well mixed; then one ounce of water is put with it, which again withdraws the alcohol from the oil, and collects at the bottom of the bottle as dilute alcohol, where it should be permitted to remain until the oil has been used, with perhaps an occasional shake-up when the bottle has been opened. Oil of lemon treated in this manner has been kept fresh and fragrant for over a year. Oil of orange may be treated in the same manner with excellent effect.

Family Bread.—Take one quart of sifted flour, and half a pint of lukewarm water; mix these into smooth batter, and stir into it half a gill of yeast, cover it with flour, and set to rise. When it is light, add a little salt and a quarter pound of lard, and *knead all well*, with sufficient flour to form a soft dough; form this into loaves, place them in pans, and set to rise again; *when light, bake.*

To one pint of flour add one gill of yeast, and make this up with tepid milk or lukewarm water into a soft paste; then cover it with about a pint of flour, and set to rise in a warm place, and when quite light work well in two quarts of flour, and milk sufficient to make it into a stiff dough, adding a little salt; knead it well and set to rise again. Bake in pans.

Use soda or saleratus dissolved in a little milk.—*Confectioners' Journal.*

NEW ALLOTROPIC MODIFICATION OF COPPER.

M. SCHUTZENBERGER has recently called the attention of the French Academy of Sciences to a new allotropic modification of copper which he has discovered, and which occurs under the following conditions: A ten per cent. solution of acetate of copper, previously boiled to expel a little of the acid and to render the bath basic, is electrolyzed with two Bunsen elements. The electrodes are separated by an interval of from 1·2 to 1·6 inch. The negative plate of platinum should be a little smaller than the positive plate of copper and placed parallel therewith. The side of the negative plate which faces the positive plate becomes covered with allotropic copper, while on the other side appears a deposit of ordinary copper, only much thinner than usual. Both kinds of copper can be deposited side by side by making the platinum electrode considerably larger than the copper one.

The metal thus obtained is not so red as ordinary copper, and is rather of a bronze color. The electrolytic deposit forms on the edge of the electrode quite prominent arborescences, and when removed it is friable, not malleable, and may be reduced to an impalpable powder in an agate mortar. An imperfect determination of its specific weight gives 8 instead of 8·9, that of ordinary copper.

While ordinary copper scarcely attacked by nitric acid at 10 per cent. or more concentrated disengages under such conditions nitric oxide, allotropic copper treated by the same acid is first scaled and then attacked. The gaseous disengagement is almost pure protoxide of nitrogen, and a dark olive black surface is formed of indeterminate nature. From a mixture of the two coppers the acid disengages both protoxide and binoxide of nitrogen. The action of heat, as well as the prolonged contact of a dilute solution of sulphuric acid, converts the allotropic into ordinary copper.

M. Schutzenberger is assured that these special properties cannot be ascribed to the presence of a hydride of copper or to occluded hydrogen. They are only explicable, he thinks, by the existence of a special modification of copper susceptible to oxidation cold and of giving with nitric acid the reactions we have noted above.

COLORS OF BIRDS AND INSECTS.

MR. ALFRED R. WALLACE has succeeded in writing a most interesting volume on the peculiarities of tropical life, and this chiefly from the results of his own long experience of nature in the eastern and western tropics of the equatorial zone, while his theory to account for the diverse colors, the special adornments, and the brilliant hues which distinguish certain male birds and insects—a theory quite opposed to that of Mr. Darwin's—cannot fail to attract the attention of all interested in this subject.

Mr. Wallace's account of his theory is perhaps the most important portion of his book; he finds, on close examination, that neither the general influence of solar light and heat, nor the special action of variously-tinted rays, are at all adequate causes for the many wondrous complexities of colors with which we are acquainted. He would therefore take another view, dividing the colors into groups, as they are protective to the creature, act as warning colors, or sexual colors, or typical colors, or simply as in floras, attractive colors.

Mr. Darwin's theory on this subject of colors was that all, or almost all, the colors of the higher forms of animal life were due to voluntary or conscious sexual selection, and that diversity of color in the sexes is due at least, first of all, to the transmission of color variations either to one sex only or to both sexes, the difference depending on some unknown law, and not being due to simply natural selection; but Mr. Wallace regards this view as erroneous, and to him the very frequent superiority of the male bird or insect in brightness of color, even when the general coloration is the same in both sexes, seems to be due primarily to the greater vigor and activity and the higher vitality of the male. He reminds us that the colors of an animal usually fade during disease or weakness, while robust vigor and health add to their intensity. This intensity is most developed in the male during the breeding season. It is also very general in those cases in which the male is smaller than the female. This greater intensity of coloration in the male would be further developed by the combats of the males for the possession of the females. Increased vigor, acting thus on the epidermal system, would soon produce further distribution of color, and even new tints and markings. Nay, even the remarkable display by so many male birds of their peculiar beauties of color and plumage may be thus accounted for, for at the pairing season these birds are in a state of the greatest energy. Even unornamental birds at such a season flutter and spread out their wings and erect their head-crests or their tail-feathers; and there would be a progressive development of these ornaments in all dominant races; and if those portions of the plumage which were originally erected under the influence of anger or fear became largely developed and brightly colored, the actual display under the influence of jealousy or sexual excitement would be quite intelligible; the males would soon find what plumes were most effective, and would endeavor to excel their rivals.

It will thus be seen that Mr. Wallace's theory of color might almost be called a molecular one. The causes of color are due to molecular or chemical changes of certain substances, and on the action on these of light, heat, and moisture. They can be produced or intensified by processes of development, and this as the surface bearing these colors is extended or diminished, and as there is a surplus of vital energy; or they may be, as in plants, acted on by some as yet unknown local action dependent on the soil or on vegetation.

Doubtless this theory will give rise to much controversy, and in the course of this no doubt many important facts will be elucidated. Thus Mr. Wallace reminds us that, in the case of those female birds with brighter plumage than the males, the females are larger, more pugnacious, and show more of vital energy.—E. PERCEVAL WRIGHT *in Nature.*

MICROSCOPY.

Minute and Low Forms of Life.—The Rev. W. H. Dallinger lately delivered a lecture at the Royal Institution on the highest powers of our best lenses applied to continuous research. Most of the lenses employed by him were quite new; one of them, a 1-35 inch glass, was made by Powell & Lealand specially for the lecturer, with a view to these particular researches. The organism whose life history was studied was one of the septic or putrefactive series, but one quite new to science. The lecturer found it some years since, but never was able to get it in a condition fit for study until 1876. It was then found in a maceration, in which the body of a water-rat was decomposing. It had been repeatedly found as small as the $\frac{1}{8000}$th of an inch. It never exceeded the $\frac{1}{1000}$th of an inch. Its form was a long oval, constricted just above the middle of its long diameter. It had three motile fibers, known as *flagella*, two at the sides and one in front, and by the aid of these its marvelous agility and grace of motion were effected. It was an apparently structureless speck, but its seeming exertion of volition, in all its diversities of movement, could not be seen without wonder. Besides its movements of translation, however, it had another, in which its lateral flagella were fixed to some object, and by means of a rapid coiling and darting motion it—by its enormous numbers—powerfully assisted in breaking up the tissues of the decomposing mass. No change ensues in this state; but they do not remain long in it, a constant flow of organisms to and from any given piece of decaying tissue constantly going on. But if one were steadily followed in the free-swimming state, it was soon seen by a most delicate and complex process to *divide itself into two* through its long diameter. But in doing this a new lateral flagellum was provided for each by the pulling out of a neck of sarcode uniting them into a delicate thread, which snapped in the middle and set them both free as perfect forms. This goes on with great rapidity for from four to seven hours; then the process stops, ending in the death of a proportion of the forms followed, but resulting in a striking metamorphosis in others, by means of which the lateral flagella are lost, and the organism becomes a smooth oval with one flagellum. This unites with an ordinary form; they fuse together, assume a spindle shape which is quite still, and ultimately this bursts, pouring out a host of nearly opaque spores, or eggs so minute that the lecturer stated it as his conviction that lesser objects than these would not become definitely visible to our highest lenses. These spores were steadily watched, and were seen to develop into the full size and form of the adult. Another form from the same series of organisms was then described—one that had been worked out jointly by the lecturer and Dr. Drysdale—and the contrast and diversity taken in connection with the unity of vital method aided in generalization. These forms, low and little as they were, were palpably as rigid in their metamorphoses as a butterfly or a wasp. If "heterogenesis"—the transmutation of one organic form into another—were found anywhere it ought to be here; but no trace of it was ever visible if the search and study were sufficiently prolonged and careful. The sequential study of the lowest organism showed that the only changes to which it was subject were those contained in the great Darwinian doctrine of the origin of species. The question of the relative capacity for resisting heat in the spore and the adult was next considered. Two methods were adopted—*dry* heat, and heat endured in a fluid.

Poisonous Caterpillar.—At a recent meeting of the Microscopical Society of Liverpool, Mr. H. C. Beasley described and exhibited the spines and hairs of a poisonous caterpillar from San Paulo, Brazil, which was referred to in a communication from Mr. E. D. Jones, read at a late meeting of the Literary and Philosophical Society. The caterpillar was covered with reddish-brown hairs, growing in tufts, and at the base of each tuft was a cluster of 20 or 30 minute hollow spines, the largest about the two-hundredth part of an inch long. At the base of each spine was a bulbous expansion, which it was supposed served as a reservoir for the poison ejected through the spine into the wound.

"*Sphærosira Volvox*" (*Ehrenberg*).—The President, Mr. Chantrell, made a short communication on the "Sphærosira Volvox" (Ehrenberg), a phase in the life history of the "Volvox globator." He stated that Ehrenberg, the great German microscopist and early writer on this subject, considered the volvox to be an animal, and that the sphærosira was a distinct species. Subsequent investigators, among whom were Professors Siebold and Cohn, W. C. Williamson, George Busk, Dr. J. Braxton Hicks, H. J. Carter, and others, have come to the conclusion that the volvox is vegetable. Mr. Carter was of opinion that the sphærosira is a spermatic form of volvox. Mr. Chantrell said that in his own investigations he had found that not only were the discoidal forms (with their antherozoids) and oospores to be found in the entire volvox, but that in some cases the volvox would contain eight or nine daughter cells, six or seven of which would have the usual grand-daughter cells, but the remaining two cells would consist entirely of sphærosira forms and oospores. These he had seen twisting about alive in the cell, and in process of time would come away, moving

at first slowly and gradually quicker, until at last he had seen them chasing, as it were, the oospores, the antherozoids of which intercepted the oospores and fertilized them Drawings from life were exhibited showing this, and also the mounted slides of the objects themselves by himself, and also stained specimens by Mr. James Abbott, of Leeds. Mr. Chantrell hoped that during the coming months of the recess members would take the opportunity of investigating this little-known subject and confirm his observations. His specimens were gathered in the month of August last, and again this May

Mr. W. H. Weightman then read a short paper on the "Polyzoarium of Onchospora hirsuta," an Australian polyzoon, prefaced by some remarks on the polyzoa generally. He mentioned the existence of a considerable number of radical tubes of a crosier-like form arising from the base of the lowest internode in this species, which had apparently escaped the notice of Mr. Busk, when describing it in the "Microscopical Transactions," and he exhibited some mounted slides of these radical hairs, as also an enlarged drawing of one of them. He then gave some hints as to collecting, drawing and mounting various spines of this class, and illustrated the paper by several preparations of onchospora and other genera, and with living examples of the genera of Alcyonella, Fredericella and Lophopus, living specimens of which had been forwarded to him by Mr. Thomas Bolton, of Birmingham.

ON THE ESTIMATION OF THE NATURAL TARTRATE OF LIME PRESENT IN CRUDE ARGOLS.

By M. A. SCHEURER-KESTNER.

THE analysis of argols and other substances containing tartaric acid has latterly assumed greater importance as the value of these products has increased, and as the growers of wines, seeking to turn to account substances which have previously remained without application, have introduced into the market new wares whose composition is less simple, and which necessitate more complete methods of examination.

Argols and dregs of wine are composed essentially of the bitartrate of potash, with which tartrate of lime is often found mixed. The other constituents vary greatly. To determine the bitartrate of potash a standard alkaline liquid is generally employed, which is caused to act upon the hot solution of the sample in water. It has, however, been found that this process very often gives too high results. Certain argols, and especially dregs of wine, contain acid substances of the nature of tannin, which redden blue litmus paper, and neutralize the alkaline liquid just as the bitartrate of potash would do. To obtain correct results it is therefore necessary to calcine the product, and in the residue to determine the potash by means of a standard acid. [But what if carbonate of soda has been fraudulently added? In this case the total quantity of alkali found after calcination will be relatively larger than in a genuine sample, and if it is all calculated as having been present in the state of a bitartrate, the value of the sample may be very much exaggerated, without the total acidity of the original sample is determined with standard alkali as a check-test.—ED. *Chemical Review.*]

The determination of the tartrate of lime is often made by dissolving a part of the sample in muriatic acid, and precipitating with caustic soda. This method gives satisfactory results if the sample of argol is free from the sulphate of lime. If not, the figure obtained is always erroneous, the error being in proportion to the quantity of plaster present in the liquid. This is a well-known reaction, but one which chemists do not always take into account when analyzing substances containing tartaric acid.

It is known, in fact, that sulphate of lime in contact with a solution of a neutral alkaline tartrate is transformed into neutral tartrate of lime, while the alkali unites with sulphuric acid. This reaction is so definite that in certain establishments it is employed for preparing tartrate of lime as a preparatory step to the manufacture of tartaric acid. As soon as the muriatic solution of the argol is neutralized, in order to throw down the tartrate of lime, the most favorable conditions are reached for the formation of this body at the expense of the sulphate of lime, and if, as it often happens, that body is present in the solution, the quantity of tartrate of lime found will exceed that which was originally present in the sample.

Some authors have recommended the following process for the estimation of the tartrate of lime. The sample is calcined, when the tartrates and bitartrates are converted into carbonates. The carbonate of potash is dissolved out in water, and the quantity of bitartrate originally present is found by titrating the solution. The carbonate of lime which is separated from the carbonate of potash by filtration is next titrated, and shows the proportion of tartrate of lime originally present. But this process is inaccurate if sulphate of lime is present, as this salt is decomposed by the carbonate of potash.

The presence of sulphate of lime in argols being frequent, it is necessary, in order to find their value in tartaric acid, to have recourse to methods not affected by its influence. It is impossible, from the reasons given above, to determine with exactitude the relative proportions of the two tartrates in presence of sulphate of lime. The only method consists in determining the total tartaric acid by transforming it all into a lime salt.

For this purpose the argol or other tartaric substance is dissolved in muriatic acid. The solution is filtered and saturated with a solution of caustic soda, and then mixed with a solution of chloride of calcium. All the tartaric acid is thus precipitated as tartrate of lime. The precipitate is washed, calcined, and the quantity of carbonate of lime obtained is found by titration in the ordinary manner.

If another portion of the argol has been previously titrated with a standard alkali, it is easy from these two data to calculate the respective quantities of bitartrate of potash and tartrate of lime in the original sample. This, however, is only possible when the argol or tartar is free from other acid products. [Hence, if sulphate of lime and the bodies resembling tannin above mentioned are simultaneously present, the method cannot be trusted. In case of "prepared tartars" and "tartar substitutes" it will be necessary to make a separate determination of sulphuric acid.—ED. *Chem. Review.*]—*Moniteur Scientifique.*

DETERMINATION OF THE ACETIC ACID IN VINEGAR.—C. JEHN.—The author's method, which is designed for rapid technical work, consists in introducing 10 c.c. of the vinegar into a flask, containing an excess of sodium bicarbonate, from which the resultant CO_2 is conducted into a second flask filled with water. The volume of water expelled from this flask is collected in a cylinder which can be calibrated so as to show percentages at once.

PRESERVATION OF IRON.

THE process of preserving iron by means of a coating of its own oxide, recently introduced by Professor Barff, is one which gives such excellent results that we are somewhat surprised at having heard little or nothing of it since its discussion at more than one scientific meeting. There are other workers, too, in the same direction, one of whom, Mr. George Bower, of St. Neots, has shown us a number of specimens of his work. These yield nothing in appearance to the samples of Professor Barff, and their protective coating is fully equal in efficiency, since it is identical in chemical composition. The process by which they are prepared is the outcome of a most elaborate and costly series of experiments which have been carried out at Mr. Bower's works in St. Neots. It may be explained in a few words to consist in exposing the iron at a suitably elevated temperature to the action of the oxygen of the air. This action forms a coating of the oxide known to chemists as magnetic oxide of iron, which is incapable of change under any ordinary conditions, and which forms on the surface a harder and more coherent film than can be obtained by any other means. Professor Barff, as our readers know, utilized the well-known fact of steam being decomposed in presence of red hot iron, hydrogen being set free and a coating of magnetic oxide of iron formed on the surface of the iron, thus: $Fe_3+4H_2O=Fe_3O_4+4H_2$. It has not, however, been generally known that free oxygen, as it exists in the atmosphere, is also capable of coating, under suitable conditions, the surface of the iron with the same oxide as that yielded by steam. To Mr. Bower is due the credit not only of satisfactorily eliciting this important fact, but also of its industrial application. The advantages that air must possess over steam are almost too obvious to require enumeration, and from an economical point of view alone the process deserves every encouragement.

The coating given by the use of air, although permanent and lasting, is of peculiar beauty, and of a grayish or neutral tint, so that for many purposes the necessity of further ornamentation by painting, etc., is dispensed with. The coating has been tested under the severest conditions, and has always resisted most completely all attempts to set up rusting. It should also be mentioned that although the iron may rust at spots from which the magnetic oxide has been removed, the rusting is confined to those spots, the lateral rusting which makes the use of paints, etc., objectionable, not taking place to even the slightest extent.

The method adopted in carrying out this process is to place the articles in a chamber, which is capable of being completely closed, and gradually raise the temperature to the requisite degree, ranging between a dull and a bright red heat, according to the ultimate use to which the articles may be applied. Air is then passed in, and the chamber completely closed for one hour, when the inlet and outlet pipes are again opened and a fresh supply of air sent into the chamber, which is again closed. This renewal of the air at the end of every hour is continued until the required thickness of magnetic oxide is formed on the iron. The air is supplied from a gas holder, or else by connecting the outlet pipe with the draught of a chimney shaft in connection with the furnace heating the chamber. The process is found to answer particularly well for cast iron, but with a slight modification, which is now being worked out, it answers equally well for every other description of the metal.

ON THE CORROSION OF PLATINUM BY SULPHURIC ACID.

By M. A. SCHEURER-KESTNER.

I HAVE formerly pointed out that in the industrial concentration of sulphuric acid in platinum vessels, the quantity of this metal which dissolves in acid free from nitrous compounds is so much the greater as the acid is more concentrated. Further experiments undertaken with the object of preparing fuming sulphuric acid have led me to continue these observations, and to find that the solution of platinum, so much promoted by the concentration of the acid beyond 95 per cent., is still further increased when the concentration of monohydrated acid is exceeded.

In the hope of effecting the industrial preparation of the so-called Nordhausen acid, by taking advantage of the decomposition of the bisulphate of soda, I had an earthen retort constructed, lined with a sheet of platinum, secured by means of autogenous soldering. The bisulphate of soda was decomposed by heat, and the fuming sulphuric acid condensed in earthen vessels. A certain number of operations were made with this apparatus, the platinum of which weighed 5 kilogrammes = 10 lbs. 15 ozs. But after the lapse of some time, on verifying the weight of the metal, it was found to have decreased in a very considerable proportion. The decrease amounted to 100 grammes of platinum for a production of 100 kilogrammes of fuming sulphuric acid. The acid had, therefore, carried off 1 gramme of platinum per kilogramme of acid, or 2 lbs. 3 ozs. per ton. The platinum was sought for in the sulphate of soda taken out of the retort. The salt dissolved in water was treated with hydro-sulphuric acid (sulphureted hydrogen). The sulphides formed were dissolved in *aqua regia*, and the solution gave an abundant precipitate of chloroplatinate of ammonia. It is to be remarked that the metal was found in a soluble state among the sulphate of soda.

We find, therefore, that with ordinary plant for concentration platinum is dissolved in sulphuric acid to the extent of 15½ to 124 grains per ton of concentrated acid, according as the product obtained contains 94 or 99 per cent. of monohydrated acid, and that in case of fuming acid the quantity of metal dissolved may reach 2 lbs. 3 ozs.

But these figures have no absolute value; they depend, all other conditions being equal, on the form of the apparatus, and on the surface of metal placed in contact with the acid While using sulphuric acid of equal purity, we may, by modifying the form of the apparatus, reduce the loss of the metal to one-fourth, or even lower. This is an improvement which has been realized by the use of the apparatus of M. Kessler, and by the more recently devised alembic of MM. Desmontes, Quenessen, and Lebrun. In these apparatus the surface of the metal in contact with the acid is much less considerable, and the liquid stratum being very shallow, renders the evaporation more easy, The boiling point of the acid is reduced, so that the quantity of aqueous acid liquid distilled is but a fraction of that in the old alembics. To these two causes, the lowering of the boiling point and the diminished surface of platinum, the reduction in wear and tear must be ascribed.—*Compets Rendus.*

OLIVE ON WOOLEN CLOTH (2 PIECES 18 KILOGRAMMES).—The cloth is boiled in a bath with 5 kilogrammes of fustic, 1½ kilogramme log wood, and completed with 500 grammes of sulphate of copper.

CONSTITUTION OF ULTRAMARINE.

By JUL. PHILIPP.

THE author finds that green ultramarine may be transformed into the blue variety by the action of boric acid, of sal-ammoniac, and of chlorine. These facts seem to favor the view that green ultramarine differs from the blue by containing an additional proportion of sodic sulphide.

EXTRACTS OF TANNIN.

IN a notice of the chief astringent extracts now met with in commerce, among the principal kinds mentioned are the Mimosa-bark extract from Australia; that of so-called hemlock bark (*Abies Canadensis*) from Canada and the United States, of which, in 1875, 6,000 tons were imported into England. Extract of chestnut-wood is made by several firms in France and Germany, and contains about 18·5 per cent. of actual tannin. In Jamaica a tanniferous extract is prepared from the leaves and branches of the pimento; and at Portland, in the State of Maine, the so-called sweet fern (*Comptonia asplenifolia ?*) has been brought into use for the same purpose.

REGENERATION OF DETERIORATED ALBUMEN.

ALBUMEN which has become partially insoluble may be restored by treatment, at 40°, with water containing 2·5 per cent. of hydrochloric acid and 7·5 per cent. of the stomachs of calves or sheep cut into shreds, the active principle being pepsine. After digestion for thirty-six hours the liquid is filtered off, and neutralized with ammonia.

THALLIUM.

PROF. SCHÖNE has executed certain experiments referring to the action of hydrogen dioxide on oxygen compounds of thallium. It appears that the hydrogen dioxide in solution, or in the state of vapor, transfers Tl_2O into a brown insoluble thallic oxide. Thallious reagent-papers turn brown in the presence of ordinary air. This was before attributed to the action of atmospheric ozone; but as Schöne found that hydrogen dioxide has the same action on these papers, the presence of ozone in the air certainly cannot be strictly determined by means of them.

LIQUID CAMPHOR.

M. WREDEN has transferred ordinary camphor by the action of dilute hydrochloric acid at 190° into a liquid isomer boiling at 187° to 193°, with a specific gravity 0·913 (at 0°). The compound only condenses at —17°, and solidifies at a much lower temperature. Such a solution absorbs oxygen from the air, especially in sunlight. The isomeric compound, on being boiled with an ammoniacal solution of silver nitrate, yields no silver mirror. At present the author is working out the theory of the formation of this curious compound.

SPONTANEOUS IGNITION OF ZINC.

IN the chemical works of Ludwigshafen (we learn from *Ch. Centralblatt*) explosions have often happened in dissolving large quantities of zinc in muriatic acid for production of chloride of zinc, and this without the air of the workroom coming in contact with fire. They were proved, indeed, to be spontaneous. M. Hofmann explains the phenomenon thus: The hydrogen gas developed raises the zinc, made very porous by action of the acid, above the surface of the liquid, so that the finely-divided zinc, in contact with air and hydrogen, causes, like spongy platinum, the inflammation of the gas mixture. A similar experience was had in the chemical works of Schering, in Berlin, some years ago, but was not explained. It is recommended to effect the dissolution of large quantities of zinc in dilute acids in open rather than closed vessels, so as to weaken the force of any such explosions.

OPTICAL ROTATORY POWER OF LIQUIDS.

By O. HESSE.

IF a solvent exerts an influence upon an optically active body, the rotatory power in question furnishes a standard for the work effected by the power of permanence of the active substance, and by the intensity with which the inactive particles react upon the active ones. It must be assumed that one series of solvents will behave alike with respect to an active body dissolved and inversely, but that others will behave differently, so that one and the same body may have several limited rotatory powers. The temperature also may have an influence. Thus certain kinds of sugar may have several limited rotatory powers for one solvent. In order to determine the limited rotatory power of a substance, it is, therefore, necessary to particularize the quality of the solvent and the method of solution.

GUAIACUM RESIN REAGENT.

By ENRICO PURGOTTI.

SCHOENBEIN pointed out that the compounds of copper in presence of hydrocyanic acid or of cyanides produce indirectly the reactions of ozone, and in particular that of giving a blue color with the tincture of guaiacum. The author finds that besides the cyanides, ferro-cyanides, nitro-prussiates, sulphocyanides, the alkaline and alkaline-earthy chlorides produce the same effect.

LAW OF AVOGADRO AND OF AMPERE.

By M. A. WURTZ.

THE author infers from his experiments that dry oxalate of potassium becomes hydrated in the same manner in an atmosphere of chloral hydrate, and in an atmosphere of moist air, or chloroform containing watery vapor at the same tension as the atmosphere of chloral hydrate. Hence he concludes that the latter is entirely dissociated, for the watery vapor which it contains is absorbed sensibly in the same manner as the vapor of water freely contained in an artificial atmosphere at the same tension.

REPRODUCTION OF QUARTZ.—M. P. HAUTEFEUILLE.—At the temperature necessary to maintain the tungstate of soda in fusion, about 750°, grains of amorphous silica disappear, and are succeeded by agglomerations of transparent rods, and if the heat is continued for several hundred hours, double hexagonal pyramids appear, having all the characters of the quartz.

OUTLINES OF CHEMISTRY.

By Henry M. McIntire, M.E.

Chlorine (atomic weight, 35·5; symbol, Cl).—Chlorine (a word from the Greek, and meaning green, from the color of the gas) is, at the atmospheric pressure, a gas having a yellowish-green color, and an unpleasant, irritating odor, producing, when inhaled, irritation of the throat and coughing, and even, in extreme cases, death. It is heavier than air, and absorbed by water with great rapidity. It will not burn, but supports combustion after a fashion; a candle being placed in it burns with a reddish flame, giving off a great amount of smoke. Many metals, if they be brought in contact in a finely-divided state with chlorine, will burn, owing to the direct uniting of the metal and the gas. Many organic compounds will also burn in this gas, owing to the uniting of the chlorine with the hydrogen of the body. Indeed, if equal volumes of hydrogen and chlorine be brought together in the sunlight, they will unite with an explosion, but will still occupy the same space. If the experiment be performed in subdued light, the combination will take place gradually; and if in the dark, not at all. A spark of electricity or of fire will be sufficient to produce their instant combination. The substance resulting from this combination is hydrochloric acid, chlorohydric acid, muriatic acid, or hydric chloride, HCl. It, at the usual atmospheric pressure and temperature, is a gas, having an acid taste and a pungent odor; irritating to the eyes, and, when inhaled, nose and throat, producing coughing. In damp air it fumes, owing to its uniting with the moisture of the atmosphere. Under forty atmospheres pressure it is condensed to a limpid liquid. But for general uses its great affinity for water is made use of, and a solution of it in water is used whenever the acid is required. The acid unites with bases to form chlorides.* (The great affinity of chlorine and hydrogen for each other is utilized in several ways. Chlorine, when passed through water, will take the hydrogen from the water, liberating the oxygen, which latter will then unite with something else, oxidizing it, of course; hence chlorine in the presence of water is an oxidizing agent. This reaction does not take place, though, unless there is something for the oxygen to unite with; that is, chlorine cannot take the hydrogen from the oxygen, leaving the latter to pass off in a free state. This oxidizing property is what makes chlorine a bleaching agent, the oxygen doing the bleaching.) The series of oxides of chlorine would be: 1, hypochlorous oxide, Cl_2O; 2, chloric trioxide, Cl_2O_3; 3, chloric tetroxide, Cl_2O_4; 4, chloric pentoxide, Cl_2O_5; 5, chloric heptoxide, Cl_2O_7. Of these the first three have actually been obtained; the remainder are only theoretical.

Hypochlorous oxide, or *hypochlorous anhydride* (Cl_2O), is a deep red liquid, emitting a vapor of a deeper color than chlorine, and of an irritating odor. The liquid is easily decomposed. The heat of the hand is sufficient to decompose it with enough violence to cause an explosion. With water it forms hypochlorous acid, or hydric hypochlorite, HClO ($Cl_2O+H_2O=2HClO$), which, in a concentrated form, is very unstable, being decomposed into chlorine and chloric acid. It is a powerful oxidizing agent, and a stronger bleaching agent than chlorine. It, or some of the salts which it forms with bases (hypochlorates), are much used for the latter purpose.

Chloric trioxide, or *chlorous anhydride* (Cl_2O_3), a deep yellowish-green gas, which is very explosive, and forms with water—

Chlorous acid, or *hydric chlorite*, $HClO_2$ ($Cl_2O_3+H_2O=2HClO_2$), an acid possessing bleaching properties and forming with bases salts called chlorites.

Chloric tetroxide, or *peroxide of chlorine* (Cl_2O_4), is, at the usual temperature and pressure, a gas of a very deep yellowish-green color, which, on a slight pressure or lowering of temperature, is condensed to a red liquid, which is very explosive. Its corresponding acid would be $H_2Cl_2O_8$ ($Cl_2O_4+H_2O=H_2Cl_2O_5$), but no such acid has ever been separated, nor any salts of such an acid obtained.

Chloric pentoxide, or *chloric anhydride* (Cl_2O_5), the next oxide, theoretically, has never been found, but the corresponding acid is well known, namely:

Chloric acid, or *hydric chlorate*, $HClO_3$ ($Cl_2O_5+H_2O=2HClO_3$), is, when in a concentrated form, of a sirupy consistence. It is a strong oxidizing agent, and rather unstable, decomposing by the action of the light or temperature into oxygen, chlorine, and perchloric acid.

Chloric heptoxide, or *perchloric anhydride* (Cl_2O_7), is also only theoretical, never having been separated. Its corresponding acid is:

Perchloric acid, or *hydric perchlorate*, $HClO_4$ ($Cl_2O_7+H_2O=2HClO_4$), is a colorless liquid and quite volatile. It is the most permanent acid of chlorine known, and the most powerful oxidizing agent in existence. If brought in contact with carbon, the oxidation will be sufficiently brisk to cause a very violent explosion. It forms with bases the series of salts called perchlorates.

Bromine (atomic weight, 80; symbol, Br) was discovered in 1826 by Balard. It exists in sea-weeds, sea-water, and in many salt springs. It derives its name from a Greek word signifying "an odor," on account of the unpleasant odor of the fumes of the substance, which, when inhaled, even act as a strong poison. Bromine is a heavy liquid (excepting mercury it is the only one of the elements that is liquid at the usual temperature and pressure), of a very deep red color. It is very volatile, giving off dense red vapors, resembling very much "nitrous fumes." It is to some extent soluble in water, is an oxidizing agent in the same manner as chlorine. Like chlorine, it is a bleaching agent, although not to the same degree. Indeed, it resembles chlorine in most of its properties. Like chlorine, it forms a hydrogen acid—

Hydrobromic acid, or *hydric bromide* (HBr), a colorless gas, possessing irritating properties and a strong acid reaction. When used (which is very, very seldom) it is as a solution in water, similar to hydrochloric acid. It forms with bases a series of salts known as bromides.

The oxygen acids of bromine are of but slight importance. By the analogy of chlorine there must be the same number of oxides and corresponding acids, but so far none of the oxides and but few of the acids have been isolated. There may be mentioned, however, as of some importance—

Bromic acid, or *hydric bromide* ($HBrO_3$), which is not made use of in the free state, but which forms a series of salts called bromates.

Iodine (atomic weight, 127; symbol, I).—Iodine exists in sea-water, sea-weeds, some mineral springs, and in one or two minerals. It was accidentally discovered in 1811 by Courtois. It is, when in a free state, in crystals or in crystalline plates of a bluish-black color. When heated, it melts, boils, and passes into a vapor of a beautiful purple color, from which characteristic it obtains its name (iodine being derived from a Greek word meaning violet colored). It is to some degree volatile in the air, giving an odor resembling that of chlorine in a feeble way. It is slightly soluble in water, and freely soluble in alcohol, ether, or solutions of the iodides. When taken internally in large doses it is poisonous, but when in small doses it is a quite valuable medicine. It is particularly efficient for external use. It possesses many properties possessed by chlorine and bromine, but to a much less degree than either of them. Like chlorine and bromine, it has one hydrogen acid—

Hydroiodic acid, or *hydric iodide* (HI), a gas, fuming in the air, and possessing a strongly acid reaction. It is quite rapidly dissolved in water, and may even be obtained in a liquid form by a strong pressure. It forms with bases a series of salts called iodides.

There have been two oxides of iodine recognized, iodic pentoxide, or iodic anhydride (I_2O_5), and iodic heptoxide or periodic anhydride (I_2O_7). The acid corresponding to the first of these is iodic acid or hydric iodate (HIO_3), which forms iodates with bases. The acid corresponding to the heptoxide is periodic acid or hydric periodate (HIO_4).

Before passing to the next substance, it may not be out of place to speak of the similarity of the three last mentioned substances—chlorine, bromine, and iodine—a similarity which has caused them to be united into a class called, as before mentioned, halogens, and which is so apparent that it cannot fail to be noticed by the most casual observer. We have the three elements—chlorine, bromine, and iodine. Chlorine is transparent, bromine translucent, and iodine opaque; the first a gas, the second a liquid, and the third a solid; the first having an atomic weight of 35·5, the third one of 127, and the second one of 80, as near a mean between the other two as may be. And further, the first has a specific gravity of 2·47; the third, when in a gaseous form, one of 8·71; and the second, in gaseous form, one of 5·54, a mean between those of the first and third. The properties of the three are similar, being possessed by chlorine to the greatest degree, by iodine in the least, and by bromine intermediately between the two. Then again the three unite with hydrogen in exactly the same manner to form hydrogen acids; they often replace hydrogen, either partially or completely, in various compounds. Their salts of the same metal are *isomorphous*—that is to say, they crystallize in the same forms; for example, potassium chloride, potassium bromide, and potassium iodide crystallize in the same form, that is, in cubes. They each form oxides and corresponding acids according to the same plan, although some of the oxides and acids are wanting with each element. In a word, they each possess characteristics so strikingly and decidedly alike that they together form a class of substances more clearly defined than any other in which the various elements have been divided.

Fluorine (atomic weight, 19; symbol, F).—Fluorine has so many characteristics similar to the three elements last mentioned that it is generally classed with them. It is a most difficult thing to obtain it in a free state; all processes similar to those used for obtaining chlorine, bromine, and iodine fail completely. But by using silver fluoride and iodine, fluorine is obtained in the form of a colorless, permanent gas. One thing remarkable about fluorine is that it forms no oxide, nor any compounds with oxygen. There is, however, one acid—

Hydrofluoric acid, or *hydric fluoride* (HF).—This acid is a colorless, volatile liquid, fuming very strongly in the air. It is very dangerous on account of its caustic action on the skin, a slight drop producing a painful wound. When poured into water it unites with it with a hissing sound, and producing great heat. The most useful property of the acid is its power to etch glass, which is made use of as a test for the acid; also for the purpose of producing various devices upon the glass.

Sulphur (atomic weight, 32; symbol, S), a well-known substance that occurs in nature in its free state. In commerce it is obtained either in round sticks called "brimstone," or "roll sulphur," and in a coarse powder called "flowers of sulphur." It exists in various different forms, thus: in the crystalline form, as found in nature; in a crystalline form, obtained by melting the sulphur and allowing it to cool, when it crystallizes in an entirely different form from that found in nature; and thirdly, in a soft, gummy form, obtained by heating the sulphur up to a temperature of 500° Fahr., and then suddenly cooling it, by pouring it in a thin stream into cold water; this variety returns to the usual brittle kind after an exposure of two to three hours. Sulphur is very inflammable, taking fire when heated in the air at a temperature somewhere around 500° Fahr. When heated it commences to fuse at 239° Fahr.; is a transparent, yellow, and quite limpid liquid at a temperature of 265°; as the heat rises, the color deepens through brown almost to black. At about 350° the liquid becomes viscous and like treacle; it can then hardly be poured. When the temperature reaches 450° it again becomes more liquid, although not so fluid as when first fused; it is then a dark, reddish-black, thin liquid, which it remains until the temperature reaches 900°, when it boils and gives off red-colored vapor, which may be distilled.

There are two compounds of hydrogen and sulphur, the first of which is

Hydrosulphuric acid, dihydric sulphide, or *sulphureted hydrogen* (H_2S), a colorless gas with a most disgusting odor, resembling that of rotten eggs. The gas is inflammable, burning with a pale blue flame, and forming water and sulphuric dioxide, if sufficient air be present; if not, sulphur is deposited. It is quite poisonous if inhaled, although diluted with air. It is quite soluble in water, which fact is made much use of in analytical chemistry, hydrosulphuric acid being a very important reagent in analytical chemistry. The gas, when subjected to a heavy pressure, may be condensed to a liquid. With bases it forms salts known as sulphides. The other compound of sulphur and hydrogen is

Persulphide of hydrogen, or *dihydric disulphide* (H_2S_2), resembling hydric dioxide very much; it bleaches, and is most easily converted into hydrosulphuric acid; its instability signifying that it is not a "saturated compound."

There are but two oxides of sulphur known in the free state, sulphur dioxide (SO_2) and sulphur trioxide (SO_3); and while there are several theoretical ones in acids, there are but three oxygen acids of sulphur that are of importance enough to consider here: Sulphurous acid, H_2SO_3 (from sulphur dioxide, $SO_2+H_2O=H_2SO_3$), sulphuric acid, H_2SO_4 (from sulphur trioxide, $SO_3+H_2O=H_2SO_4$), and hyposulphurous acid, HS_2O_2 (from the theoretical oxide S_4O_3, $S_4O_3+H_2O=2HS_2O_2$).

Sulphur dioxide, or *sulphurous anhydride* (SO_2), generally, though incorrectly, called sulphurous acid. A gas produced by burning sulphur; it has a suffocating, pungent odor (witness the unpleasant effect of a burning "sulphur match"). It is a colorless gas, which may, by cooling or by pressure, be condensed at first to a colorless liquid, and even to a transparent solid. It is heavier than air, combines very easily with water to form the true sulphurous acid, H_2SO_3, but it is easily decomposed by heat into its constituents. It is used as a bleaching agent, and bleaches probably by forming colorless salts with the coloring matter. It does not decompose the color like chlorine, as by the use of an alkali it (the color) may be restored. It is used also as a disinfectant. It is a powerful antiseptic; in analytical chemistry it is sometimes employed as a reducing agent. It forms with bases salts called sulphites, either *acid salts* or neutral salts, as all or only half the hydrogen is replaced by a base; thus sulphurous acid, or dihydric sulphite (H_2SO_3), forms acid potassium sulphite, or hydric potassium sulphite ($HKSO_3$), and potassium sulphite, or dipotassium sulphite (K_2SO_3), as the case may be.

Sulphur trioxide, or *sulphuric anhydride* (SO_3), can be formed by SO_2 and O, existing in the form of silky needles; it can be kept, but with difficulty, as it unites very easily and violently with water, forming

Sulphuric acid, or *dihydric sulphate* (H_2SO_4), frequently called in common parlance oil of vitriol. This is the most useful acid known, and used more extensively and for more varied purposes than any other. It is an oily, colorless liquid, nearly twice as heavy as water. It is very caustic in its action, charring organic matter very readily. It has a great attraction for water, and when uniting with it develops quite a high heat. Its attraction for water extends to the vapor of the atmosphere, from which fact it is often employed as a "desiccating agent," that is, for the purpose of removing the moisture from the air, and making a perfectly dry atmosphere.

Sulphuric acid forms with bases sulphates, either acid or neutral, as the case may be.

Hyposulphurous acid, or *hydric hyposulphite* ($H_2S_2O_3$). An acid that has not been obtained in the free state, and known only in its combination with bases, as hyposulphites, of which the most important, perhaps, is sodium hyposulphite; the property by which it forms double salts with those salts of silver which are insoluble in water, which double salts are soluble in water, being made use of in photography for the purpose of fixing the image, as is very well known.

Before leaving sulphur, there is one of its compounds that is so useful, and whose usefulness is increasing so rapidly, that it cannot be passed over in silence; it is

Bisulphide of carbon, or *carbon disulphide* (CS_2). If the vapor of sulphur be passed over red-hot charcoal, this carbon disulphide is formed; it condenses to a heavy, volatile, colorless liquid, possessing an odor than which as yet none has been discovered or invented that surpasses it in disagreeableness; it is very inflammable and poisonous. The liquid itself has an acrid, pungent taste. It is insoluble in water, but freely soluble in alcohol and ether. Its great importance is due to the fact that it is an excellent solvent of sulphur, phosphorus, caoutchouc, gums, oils and fats.

The parallel between sulphur and oxygen is very striking; they are the only two elements that easily unite with carbon. We have CO_2 and CS_2; there are also H_2O and H_2S, and even H_2O_2 and H_2S_2; and what is more strange, these compounds resemble each other in more ways than in their formulæ only.—*Philadelphia Photographer.*

* Mention should be made here of a mixture of nitric and hydrochloric acids, forming what is called nitro-muriatic acid, or aqua regia. It is used to dissolve gold and platinum, from which property it obtained the name aqua regia (kingly water, or kingly liquid, gold being "the king of metals"). Neither nitric nor hydrochloric acid, when alone, has any effect on gold or platinum, but, when mixed, the metal is attacked and dissolved: the reaction being that the acids decompose each other and free chlorine is liberated, which at once attacks the metal and forms a chloride.

OXIDATION OF ALUMINUM.

By Carl John.

The author finds that aluminum amalgamated with mercury, steeped in water acidulated with sulphuric acid, and then taken out and dried, becomes subsequently covered with a white coating of alumina, among which globules of mercury are perceptible.

CRYSTALLIZATION OF SILICA.

By P. Hautefeuille.

Acid phosphate of soda and tungstate of soda are both agents in the mineralization of silica, but the latter exerts a more energetic action, even at a lower temperature, which permits its employment for the reproduction of the numerous silicates, more or less fusible, associated with silica in rocks.

OXYGEN FROM THE AIR.

G. A. Trenkler proposes to remove oxygen from the air by the following process:—The air passes through a solution of copperas mixed with iron-turnings. A combination of three small casks filled up to the top loosely with iron and sawdust, and half full of a solution of copperas, suffices to reduce the atmospheric oxygen down to 2½ per cent. The only material consumed is the metallic iron.

IMPROVED MAGENTA.

The Baden Aniline and Soda Works are now offering for sale the salts of the sulphacid of rosaniline, under the name of "Magenta S." This product differs very essentially from the salts of rosaniline (magenta) commonly occurring in commerce, being totally unaffected by acids. A solution of the dye mixed with muriatic acid retains its original color, while ordinary magenta is turned at once into a yellow.

The so-called "gas-oil" of paraffin works, which has hitherto been considered almost worthless, proves to be an available source for benzol, toluol, and anthracene. Liebermann and Burg, by passing the oil through red-hot tubes filled with charcoal, obtained 4 per cent. of benzol and toluol, and 0·9 per cent. of anthracene.—*D. Berichte der Deutsch Chem. Gesell.*

E. Solvay continues his attempts at the perfection of the ammonia-soda process. He recovers the ammonia from the liquid filtered from the bicarbonate of soda by means of magnesia or basic chloride of magnesium. From the liquid muriatic acid or chlorine may be obtained, and the magnesia employed is recovered.